Railway Mechanical Engineer

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The Unaflow Locomotive

One of the remarkable results obtained in the tests of the unaflow locomotive, which is described on another page of this issue, is the reduction of back pressure in the cylinders to a point considerably below atmosphere. This, of course, increases the efficiency of the steam cycle, as the temperature of the exhaust steam is lowered. Stationary engineers have long been able to take advantage of the savings resulting from a vacuum in the cylinders by employing a condenser, but the problem of providing a condensing apparatus for the steam locomotive of the reciprocating type has never been solved satisfactorily. Opposed to the need of reducing the back pressure is the necessity of creating a strong artificial draft in the fire box so that high rates of combustion may be maintained. This, no doubt, has tended to retard experimental work along the line of reducing back pressure in the cylinders. If the operating economies resulted in only reducing the back pressure to atmosphere the unaflow system would be worth serious consideration by locomotive designers. According to the figures reported from actual tests, it produced a vacuum as high as 60 per cent. This development of the steam locomotive promises results of practical importance which justify its intensive development.

Importance of Committee Work

It is a hopeful sign when the leaders of any industry recognize the need of joint action on mutual problems and, by faithful support of their national association and willingness to perform committee work at some personal sacrifice if necessary, do their best to promote the interests of the industry as a whole. From a purely selfish point of view this form of activity is highly remunerative. It brings men in contact with some of the leading minds in their particular branch of industry. They are broadened thereby and, moreover, have an opportunity to see and compare the merits of the best modern practices and methods. One man who has labored faithfully in railroad association work testifies that he has never attended a committee meeting at which he failed to get some idea which was worth investigating or perhaps trying out on his road.

Until a year or two ago a considerable number of railroad mechanical men failed to realize fully the opportunities of committee work in their association, either refusing to serve when their names were suggested for committee membership or permitting the use of their names and then practically never attending the meetings, answering queries or doing any constructive committee work. This condition has been most happily remedied, there being now an evident willingness on the part of practically all members of the Mechanical Division of the American Railway Association to serve on committees to which it is thought their experience will bring strength. Many of these men are now asking for work and in some cases the railroad heads have asked that their mechanical representatives be placed on committees.

Practically all assignments to committee work at the present time are accepted, and when on occasion it is impossible for a mechanical officer to serve, the reason is usually carefully and somewhat apologetically given. When once appointment on a committee is accepted, apparently every effort is put forth to do the best possible work for the committee and to attend meetings faithfully. The quality of the reports presented at the Mechanical Division convention at Atlantic City in June is proof of the faithful work done by committee members during 1923. Secretary Hawthorne of the Mechanical Division is authority for the statement that attendance at the committee meetings during the year was practically 100 per cent. For the benefit of the railroads as a whole, this kind of work should be continued.

Real Apprentice Training

The last of a series of four articles describing in detail apprenticeship methods on the Atchison, Topeka & Santa Fe appears in this issue on page 527. For a quarter of a century or more this publication and its predecessor, the American Engineer and Railroad Journal, have consistently advocated better and more effective methods for training apprentices in the mechanical department of the railroads. Nineteen years ago George M. Basford, at that time editor of the American Engineer and Railroad Journal, made an address before the American Railway Master Mechanics' Association on the technical education of railroad employees. This made a profound impression on mechanical department officers at that time and was followed by constructive developments on at least two roads.

John Purcell of the Santa Fe had always taken a deep interest in apprentice training. Mr. Basford had followed developments on the Santa Fe closely and with keen admiration for the intelligent and sympathetic interest in apprentices on the part of Mr. Purcell. Undoubtedly, also, Mr. Purcell was inspired by Mr. Basford's grasp of the importance and necessity for improving apprenticeship training methods. At any rate, the Santa Fe began to make remarkable forward strides in perfecting its apprenticeship methods. J. F. Deems, at that time general superintendent of motive power of the New York Central, was also greatly impressed with Mr. Basford's point of view and, with Mr. Basford's help, inaugurated a splendid system of apprenticeship training on the New York Central Lines. Unfortunately, while this work developed rapidly and was widely heralded, it has not been consistently carried on because of various changes in the organization. It was based on sound principles and the methods were carefully and logically developed. To some extent the work persists today, but it has not been followed up with the same persistent and intelligent effort that has characterized the Santa Fe developments.

Mr. Purcell never for a moment faltered in his effort to

make the apprenticeship training methods on the Santa Fe as constructive and effective as possible. He has been ably supported by Frank Thomas, who has given all of his energies to improving and extending the work. One secret of the success of this movement on the Santa Fe has been that in addition to the fact that no pains have been spared to carry it on, both Mr. Purcell and Mr. Thomas have a very keen sympathy for boys and young men—a sympathy so strong that it has led them, in developing their methods, constantly to strive to keep in mind the boys' point of view.

The apprenticeship methods on the Santa Fe have proved their practical worth in a large way in spite of the most severe tests to which they have been subjected. Mr. Purcell in his presidential address before the meeting of the Mechanical Division of the American Railway Association at Chicago in June, 1923, clearly emphasized the advantages of modern apprenticeship methods. This caused an awakening of interest on the part of many railroad officers and the *Railway Mechanical Engineer* immediately set about to arrange for a series of articles covering these methods in as great detail as practical, in order to give its readers a clear idea of just how the work is carried on. It has been a great source of satisfaction to us that these articles, following the results of the apprentice competition conducted by this publication a year ago, have attracted widespread interest. From the inquiries which have been made at our offices and of Mr. Purcell and his associates, we feel sure that the year 1924 is going to mark the greatest forward step which has ever been taken by the railways in the more general adoption of modern and up-to-date apprenticeship methods. Surely, in these days, when industry and the railroads at large are beginning to recognize the necessity for trained leadership, as well as the development of a more intelligent and constructive interest in industry and the railroads on the part of all of the workers, no mechanical department officer can afford to conduct apprenticeship training in an inefficient and haphazard manner. The Santa Fe has pointed the way. It has secured excellent and worthwhile results under the most severe conditions and over a long period of years. Is there any excuse for any railway mechanical department officer who fails to face squarely up to this problem by providing an up-to-date apprenticeship system in conformance with the principles which were adopted as recommended practice by the American Railway Master Mechanics' Association many years ago, but which until comparatively recently, have never received the serious consideration of more than a very few motive power officers?

Transmissions for Internal Combustion Engine Units

The successful operating results that have been obtained on many roads from the introduction of self-propelled motor cars has strengthened a demand for similar cars of greater carrying capacity. To meet this demand, new designs are being brought out. In addition, the high thermal efficiency and increasing reliability of heavy oil engines of the Diesel type are attracting a well-merited attention by progressive railroad men. The near future will very likely see a number of attempts to utilize such internal combustion engines for driving both cars and locomotives. The power transmission problem has always been a serious one in connection with the adaptation of either gasoline or heavy oil engines to railway motive power units and the problem becomes increasingly difficult as the size of the units is increased. Although mechanical transmissions as developed by the automotive industry have proved satisfactory in smaller capacities they lack complete flexibility of control. Ample starting torque, complete speed control and reliability are, however, vital if internal combustion engines are to be extensively employed for railroad motive power. Two methods of transmission appear to offer solutions of this difficult problem. One is the hydraulic system. This system has been tested to a limited extent in Europe and is now used on a switching locomotive in Canada and on a rail motor car on an American road. The other method is the electrical one, the engine being coupled to an electric generator and motors applied to the axles or trucks. This system was used on some of the early motor cars and is again being employed on some of the latest designs of locomotives and heavy rail cars. Both of these systems furnish good starting torque and full speed control, although neither is as simple or as low in initial cost as mechanical transmission mechanisms. Which one of the two systems will eventually prove to be the best suited for heavy railroad units only time and a considerable number of applications can determine. Both appear to warrant serious attention and should be considered in planning for new installations.

Railroad Shop Drilling

Which is the more important from a production point of view, the drilling machine or the operator? This question is akin to that other famous inquiry, "Which comes first, the hen or the egg?" A good drill operator handicapped by an antiquated machine cannot achieve the desired results in drilling holes, and, on the other hand, the most modern, powerful and conveniently-operated drill cannot produce the output rightfully expected of it with an indifferent operator. According to an old analysis which probably holds approximately true under present conditions, 17 per cent of the machine operations in railroad shops are drilling operations. The need for efficiency in this work is therefore apparent, both because of the possibility of decreased labor cost and because the more rapid handling of drilling work will to a certain extent help speed cars and locomotives through the shops.

Many drilling machines at present used in railroad shops and engine terminals have unquestionably outlived their period of effective usefulness. In some cases the driving motor is too small, or the driving pulley and belt does not transmit sufficient power to operate the machines at the desired cutting feeds and speeds. In other cases the clutches and gear shift mechanism for transmitting power within the machine itself are inadequate for present-day needs. Sometimes the spindle bearings are worn, or in the case of radial drills, the head bearings on the radial arm are worn beyond the point where lost motion can be taken up, with the result that the drill spindle wabbles literally "like a drunken sailor." Under such conditions it is obvious that the desired results in the production of drilled holes cannot be obtained. The best solution is to scrap the old machines as soon as possible and replace them with modern high-power drills, not forgetting that the requirements for railroad shop drilling machines are: First, adequate power for the job in hand; second, rugged design and construction to withstand the stress encountered in this class of heavy duty work; third, convenience of starting and stopping and changing from one feed and speed to another in order to conserve the operator's time and provide increased production.

In deciding on the type of drilling machine to be purchased another point to be remembered is that many railroad shop drilling operations are adequate in volume to require the full time of one or more machines and it would therefore be poor judgment to install expensive "full jeweled" drills with 30 or more speed changes when possibly less than six are used. In cases of this kind the requirements of power and ruggedness in drilling machines should be looked for and other expensive refinements eliminated.

Railroad shop managements can undoubtedly in some cases improve the present condition of their drilling equip-

ment by the addition of more powerful driving motors and perhaps in some cases by the repair and adjustment of drills. In the main, however, this is highly specialized work which the manufacturers are far better able to do both from the point of view of equipment and experience.

Besides providing better equipment shop managements can improve their drilling production by the education of drill operators as to what the modern drill can, and should, produce in the way of drilled holes. They should also provide all possible incentive and encouragement for the operators to secure this production. While it is probably not common practice, drill operators have been observed in railroad shops to operate their machines for half a day in the drilling of miscellaneous holes of all sizes in several different kinds of material without once changing the feed or speed. This is a case of pure indifference and reflects both on the drill operator and his supervisor. Either he doesn't know the relation between size of hole, feed and speed for any given material, or he doesn't care. In one case he should be instructed and in the other given an opportunity to change his attitude or compelled to work elsewhere. If he cannot be discharged, at least he can be put on some other job where he will not waste the power and time of the machine as well as his own.

Drill operators are usually paid the same rate as machinist helpers and often they adopt the "don't care" attitude because of failure to see that such an attitude will, in addition to hurting the company, delay their own advancement. Such men should be appealed to on the ground of ambition and pride of accomplishment. They should be shown the possibilities of production with modern drilling machines and high speed drills and taught to put up the feeds and speeds to the required point, changing them as often as may be necessitated by the varying size of holes and material to be drilled. Tests conducted at the Atlantic City convention indicated that with one-inch high speed drills and special drilling machinery penetrations up to 116 in. per minute in cast iron, 50 in. per minute in machinery steel and 5 in. per minute in Chrome nickel steel could be obtained. In these tests the maximum possible service was obtained from the drills, the speed being put up to a point slightly below that at which they would burn and the feed increased until the drills were near the breaking point. While these rates of penetration were obtained under special test conditions, railroad shop drills and drilling operations could be improved until a production equal to 50 per cent of these records was obtained and yet show a marked improvement over present practice in many shops.

Reports Should Be Studied

At every engine terminal or shop of any importance reports, charts or graphs are prepared for the foremen and their superior officers, which show on a monthly comparative basis various phases of the work performed. Considerable time and money is involved in the preparation of these reports by the clerical force of the various departments. The question is, do they serve their intended purpose? Those for whom the reports are intended should study them with a view to understanding the reason for them, the information contained in them and how best to use that information in obtaining better results. That this may be accomplished, detailed instructions should be issued with each report setting forth clearly how the data were obtained, the method of deriving the results shown and the object aimed at in issuing the report. Furthermore, after the supervisors have had ample time to digest the written instructions they should be called into the office where the report is prepared and closely questioned as to whether the report is fully understood. The men should be taught that the reports are not prepared primarily for the general officers of the railroad but that, except in rare instances, they are planned to provide the immediate supervisory officers with a record of the work being done. These reports should regularly be used to provide a proper incentive for the supervisors, to compare their work and their results with others and to use the results shown to inspire their associates and subordinates. Reports using the man-hour unit of measure for determining the cost of work done on locomotives and cars can be used to a good advantage if properly studied. Beneficial results can be obtained in studying the cost for each class of work performed on equipment by measuring the results in man-hours, not only for labor but for material as well. If reports of this nature are properly explained and exhibited to the workmen each month, they will know what their work is costing in comparison to that done by their associates. This will create an incentive for efficiency and economy. Foremen should be taught to analyze and use reports of this kind so that they can in turn, convey the information among their subordinates and associates and use it if they are promoted to positions of greater authority and responsibility. If they are not used as is too often the case, how can the cost of their compilation be justified?

New Books

Car Inspector's Handbook. *By E. W. Hartough, formerly general car foreman on Missouri, Kansas and Texas and Pere Marquette, 284 pages, 4½ in. by 7 in. Price $2.50. Published by the Simmons-Boardman Publishing Company, 30 Church Street, New York.*

The object of this book is to give to every interested car inspector an opportunity to obtain knowledge of his duties which could otherwise be obtained only by years of experience. The text of the book contains 23 chapters, which include train yard inspection, repair track inspection, shop inspection and interchange inspection, with many illustrations to make the subject clear. Any part of a car that requires inspection is thoroughly gone into with respect to method of inspection, what to look for, how to report the existing defects and how to designate the defect so the repairman will know what to do. An interesting chapter is devoted to interchange inspectors, which brings out the importance of their work and the thorough knowledge they must have of the rules and regulations governing their duties. The volume clearly brings out the important part which inspectors play in helping to maintain equipment and reduce repair costs and in protecting human life and property.

Arc Welding Handbook. *By C. J. Holslag, chief engineer, Electric Arc Cutting & Welding Co., 243 pages, 4¾ in. by 7½ in. Price $2.00. Published by the McGraw Hill Book Company, Inc., 370 Seventh ave., New York.*

This book describes clearly and in detail the methods of arc welding so that the equipment and processes may be thoroughly understood and the newer applications of this branch of welding more generally recognized. It is a complete working manual for welding operators and those who supervise welding jobs, and also an adequate reference guide for all concerned in any way with the use of arc welding. It describes the process of stubbing and holding an arc and points out clearly what should be done to get the best results.

Different types of welding are treated completely. Starting with definite instructions as to the formation of beads, the author covers spreading welding, over-head welding, padding welding, fillet welding, lap welding, butt welding, etc. Specific applications of arc welding are included in specific sections. Definite directions are given in chapter 15, for instance, for the successful welding of cast iron and malleable iron. In chapter 16 the welding of thin cast-iron

sections is covered. Other chapters describe the welding of all of the commonly used metals for many usual and unusual jobs. It is a plain and practical guide to its modern uses which will prove of material help to those interested in arc welding.

THE ENGINEERING INDEX—1923. 700 *pages, 6½ in. by 9½ in. Bound in cloth. Published by the American Society of Mechanical Engineers, New York.*

The twenty-second volume of the Engineering Index is the fifth one to be issued since The American Society of Mechanical Engineers acquired the Index from The Engineering Magazine Company and assumed the continuation of the service started 40 years ago by the Association of Engineering Societies. The typographical arrangement of the 1923 volume follows that of its predecessor with the exception of an improvement in the style of the main headings. It contains a brief review and index of articles which have appeared in publications and reports covering a wide variety of engineering subjects. In the preparation of this volume the staff of the Society reviewed publications in several different languages and this edition of the Index presents what is probably the most complete reference to current literature on engineering and scientific subjects in existence.

The wide range of usefulness of this edition should particularly appeal to men in the railway field. Practically every phase of the construction, maintenance and operation of motive power, rolling stock, shops, terminals, signaling, track and yards have been covered by references to articles published in the leading technical magazines of the United States and foreign countries.

PROCEEDINGS OF THE AIR BRAKE ASSOCIATION 1924. *Edited by the Secretary, F. M. Nellis, 165 Broadway, New York,* 315 *pages, bound in leather.*

This book contains the proceedings of the Thirty-first Annual Convention of the Air Brake Association which was held at Montreal, Quebec, Canada, May 6, 7, 8 and 9, 1924. The reports submitted covered Brake Pipe Leakage; Freight Car Foundation Brake Design; Condemning Limits of the A. R. A. Standard Triple Valve Parts; The Triple Valve Test Rack Operator; Reclamation of Air Brake Material; Reclamation of Hose and Fittings; Passenger Train Handling; Graduated Release; Methods of Interesting and Instructing Railway Employees in the Maintenance and Operation of the Air Brake Equipment; Recommended Practice. The reports of the secretary, treasurer and various committees are also included.

What Our Readers Think

Boiler Inspectors Should Be Examined

TOLEDO, Ohio.

TO THE EDITOR:

One has but to read the federal inspection reports to have most forcibly impressed upon him the importance of the roundhouse boiler inspector's position. It is one that carries with it the practical control of life or death for many. We have a certain sense of security when we see monthly, quarterly or yearly certificates in an engine cab and note that so-and-so by his signature and oath declares that the boiler is in safe condition to operate. Yet how much more secure we would feel if our federal laws would make it compulsory for all boiler inspectors to pass an examination conducted by federal inspectors. It would result in the weeding out of many that are not competent to hold these positions. The necessary qualifications for such positions are well defined by three requisites: Practical knowledge of boiler construction and repair, good judgment and, last but not least, the moral stamina to say no and stick to it. It is well known that many so-called inspectors have signed certificates and engines have gone into service with disastrous results, when, if they had not been so anxious to keep on the right side of their supervisors, they would have refused to sign. That is the great drawback to the proper carrying out of the law. Put the boiler inspector's position on a plane where local supervision would have no terrors for him and, with qualified inspectors, all would benefit.

In the proceedings of the recent Master Boiler Makers' convention men high in the official life of our great railroads spoke of the necessity of acquiring a staff of competent boiler inspectors. Surely these men know the necessity of such a program and it argues well for the future and speeds the day when the roundhouse boiler inspector will not be looked upon as a disturbing element in the roundhouse, but rather as one with the possibilities and importance of his position fully recognized. JOSEPH SMITH.

Qualifications for a Gang Foreman

EAST ORANGE, N. J.

TO THE EDITOR:

I have read with considerable interest your editorial in the August number of the *Railway Mechanical Engineer* on the subject of selecting a man for a gang foreman. This is a subject on which much has been said, but in many respects the problem is covered by that old saying that what looks well in theory, doesn't always work in actual practice. There are very few men living today who would come up to the specifications outlined in your editorial; in fact, I think most of them are dead.

Of course, what you have outlined are essential qualities of a foreman, but I do think that the degree in which a man will possess these essentials will vary according to the individual. I know of many foremen and supervisory officers who, after they have once been given authority, have taken upon themselves an unnatural personality which, doubtless, they believe fits the job better than the personality that the Lord gave to them. When a man has to change his countenance, expression of speech and his conduct with others in order to successfully hold down a foreman's job, it is done solely for the purpose of disguising his inherent shortcomings. Therefore, I maintain that the essential qualities of a foreman are first of all true personality, honesty and an earnest desire to produce the goods. A READER.

Who Can Answer This Inquiry?

TOLEDO, OHIO.

TO THE EDITOR:

Can some reader of the *Railway Mechanical Engineer* furnish any information in answer to the following questions:

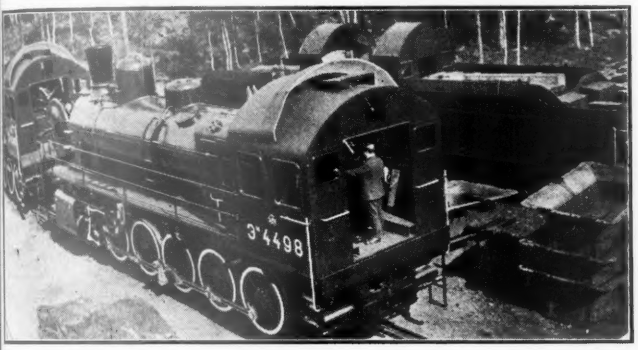
1. How many months of service should be had from a new set of side rod bushings on an eight-wheel switch engine that is used on Belt line service working 24 hr. a day and 315 days a year?
2. How many months' service should be had from a new set of tires before it is necessary to turn them? This is for the same class of service and the same type of locomotive as given in the first question. Would 1/32 in. wear for every 30 days be a fair average?
3. How many months' service should be had from a set of two-inch driving box crown brasses equipped with grease cellars, on the same type locomotive and in the same class of service, working 24 hr. a day and 315 days a year? SHOP FOREMAN.

A Unaflow Locomotive is Built for Russia

A Remarkably High Vacuum Has Been Obtained by Redesigning the Cylinder Exhaust Pipes

By Prof. J. Stumpf
Privy Counsellor, Berlin, Germany

THE first locomotive in which the unaflow principle was applied was a superheater freight locomotive of the German State Railways, was built in 1920 by A. Borsig, Berlin.* This locomotive did not prove to be a success and after operating about three years the cylinders were replaced by those of the usual type. The cylinders first used for the unaflow installation were notable for compactness, lightness and simplicity. This was due in part to the use of horizontal, single-beat poppet valves which



The 0-10-0 Unaflow Locomotive Built by Nydquist & Holm, Trollhättan, Sweden, for the Russian Government

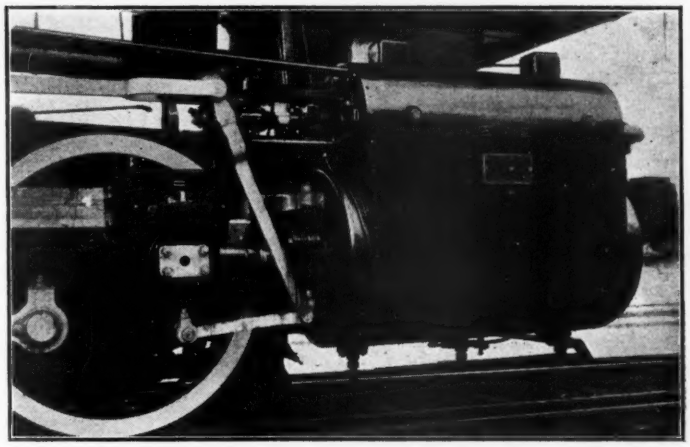
were employed for the first time on this locomotive. This type of valve, although simple and perfectly steam tight, was not favorably received because of the high lift and large force required to raise it. The cylinder bore of this locomotive was 24.8 in., with a stroke of 26 in. and it operated at a steam pressure of 177 lb. per sq. in.

The results of tests made at that time showed that the unaflow locomotive was more economical than the compound for small loads, while at higher loads its fuel consumption was higher than that of the latter. This was easily explained by the fact of the long, constant compression and the large clearance volume. The unaflow locomotive working with saturated steam showed in general a higher economy than the compound except at long cut-offs. It was concluded, at that time, that the future line of progress of the unaflow locomotive led naturally from the two cylinder to the three cylinder engine with cylinders having small clearance volume, to the use of single-beat poppet valves and the utilization of the ejector action of the exhaust, in combination with high pressure and modern superheat.

To engineers of broad vision, unsuccessful experiments are successful if they reveal the way in which success may be sought. So it was here. The exhaust ports in the cylinder wall, which are formed like a nozzle of a steam turbine, transformed the energy of the "lost toe" of the indicator card into speed energy, which withdrew residual steam from the attached single exhaust pipe. A vacuum of 60 per cent was created in this pipe, leading from the cylinders to the ejector, thus utilizing this energy, represented by the "lost toe," for creating the vacuum.

Fig. 2 shows an indicator diagram taken from the single exhaust pipe. This test was a complete success as it showed that on account of faulty connection between the cylinder and the evacuated exhaust pipe, the vacuum did not penetrate into the cylinder. The locomotive was of the pure unaflow type and it was discovered that the exhaust ports in the cylinder were closed too soon by the piston. Also the single beat valves did not prove to be a success on account of the fact that the crew failed to adjust the gear properly. However, this engine revealed the method by which success was to be expected.

The single beat valves were replaced by a positively controlled piston valve allowing for an additional exhaust which partially followed upon the main exhaust controlled by the piston. This design permitted the main exhaust nozzle to transform the pressure energy represented by the "lost toe" of the diagram, which is shaded in Fig. 1, into speed energy, so as to withdraw the residual steam from its own and of the other cylinder through the additional exhaust established by the piston valve. The gain thereby effected is shown by



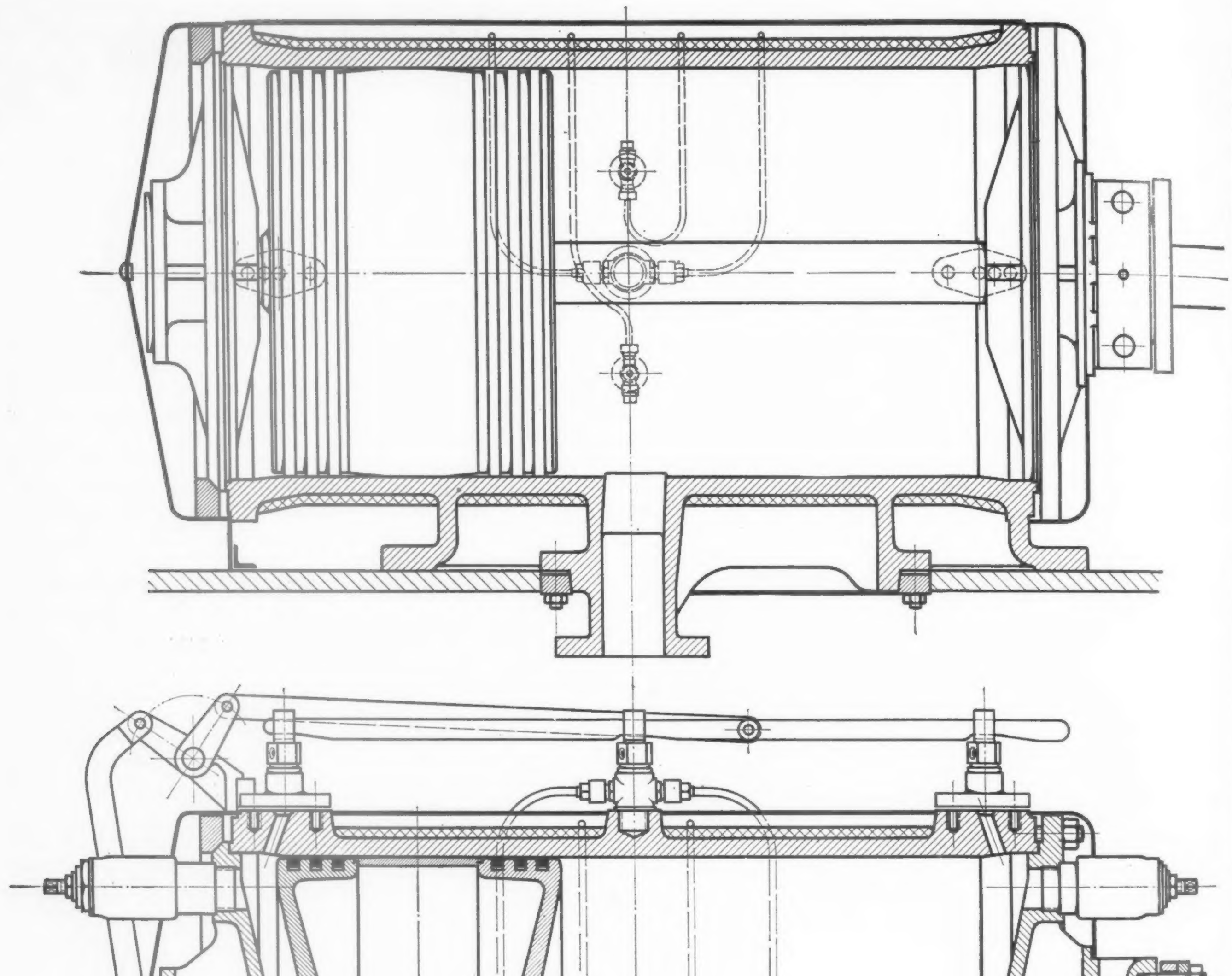
The Locomotive Is Equipped with a Walschaert Valve Gear

the shaded area below the atmospheric line in Fig. 1 which corresponds to the results from actual indicator cards with about 60 per cent vacuum.

Design of the Cylinders and Exhaust Pipe

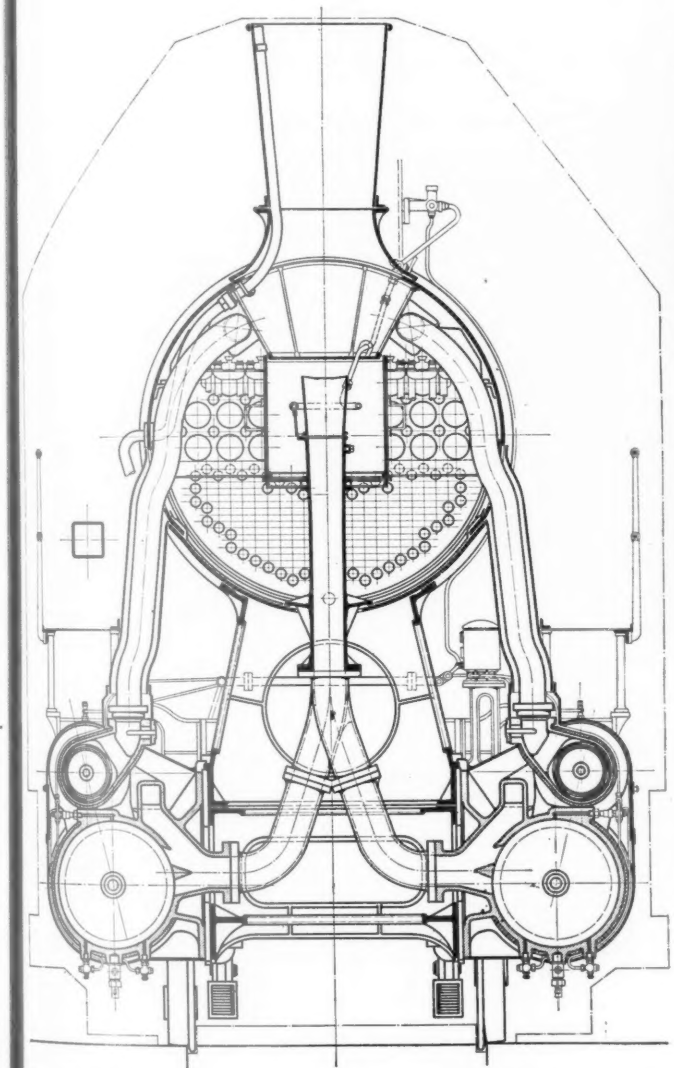
The design of the cylinders and exhaust pipe is shown in the drawings. Particular attention is drawn to the elongated type of the unaflow cylinders and pistons. The main nozzle-like exhaust ports are opened by the piston at 25 per cent of the piston stroke before the next dead center. No extended piston rod is used. Live steam is admitted to the cylinder from the inside of the piston valve in the usual way, the outer ends establishing an additional exhaust which joins the main exhaust immediately at the cylinder wall by ports cast in the wall. The exhaust lap of the valve is equal to the inlet lap, thereby delaying the additional exhaust which follows the main exhaust. This tends to effect a nearly pure unaflow at early cut-off and a semi-unaflow at late cut-off. This is an satisfactory result as there is prac-

*A description of this locomotive was published in the May, 1922, number of the *Railway Mechanical Engineer.*



Sectional Drawing Showing the Construction of the Cylinders

tically no loss at the end of the diagram at early cut-off which shows there is no need for an additional exhaust at this point and as there is considerable loss at the end of the diagram at late cut-off there is consequently a need there of an additional exhaust. Furthermore, when working with atmospheric exhaust, the pure unaflow shows greater economy at early cut-off and the semi-unaflow at late cut-off. This contrast is more favorably intensified by utilizing the lost part of the diagram to create vacuum at late cut-off. The output and economy of the locomotive will be largely increased if the back pressure of about one atmosphere, with which American locomotives are frequently worked, is replaced by a vacuum. This is all the more

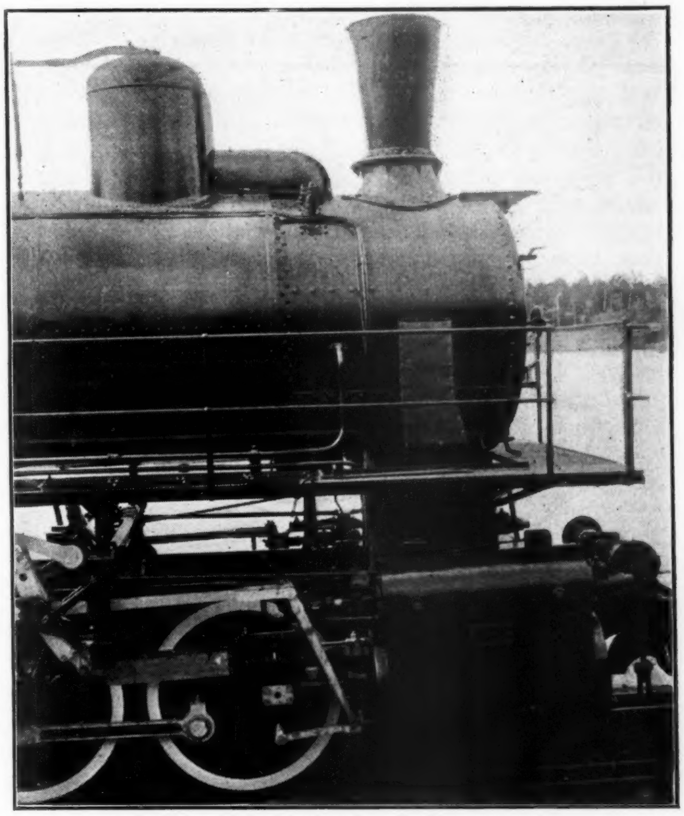


Cross Sectional Elevation Through the Smokebox Showing the Arrangement of the Cylinder Exhaust Pipes

noticeable since the unaflow system shows its beneficial thermal effect especially the larger the drop of temperature in the cylinder. The boiler will be more able to furnish the required steam, the capacity of the locomotive will be increased and in a great many cases the necessity to use a mechanical stoker will be dispensed with as the fuel consumption of the locomotive will be considerably lessened.

Effect of Uniting the Cylinder Exhaust Pipes

After the union of the three exhausts of each cylinder both united exhaust pipes become a combined ejector, so that the exhaust of each cylinder evacuates the other. By this arrangement the speed energy of one cylinder will evacuate its own cylinder as well as the other, the active steam thus mixing with the passive steam at two places and equalizing



The Front End of the Russian Unaflow Locomotive

the speed of the steam through the exhaust pipes to a large extent. This equalization is continued in the nozzle which transforms the speed energy into pressure energy, thus utilizing any remaining energy that may be left from the exhausts. The result is a fairly equalized flow of steam from the mouth of the nozzle, which tends to create a uniform draft upon the flue gases, resulting in good combustion and a good production of steam. There has never been the slightest complaint about lack of steam.

Further examination of the results in testing this peculiar suction exhaust showed a surprisingly low vacuum in the

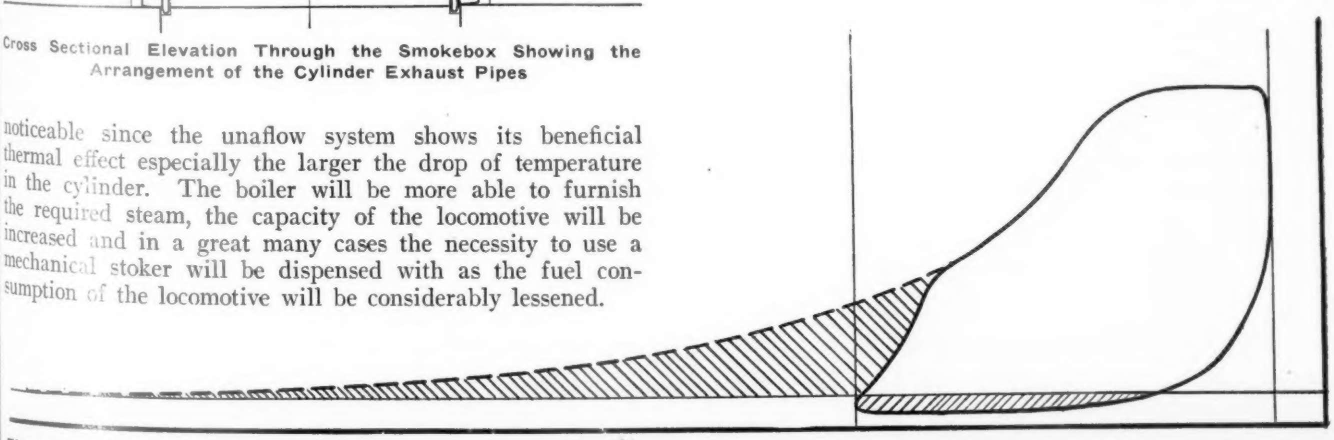
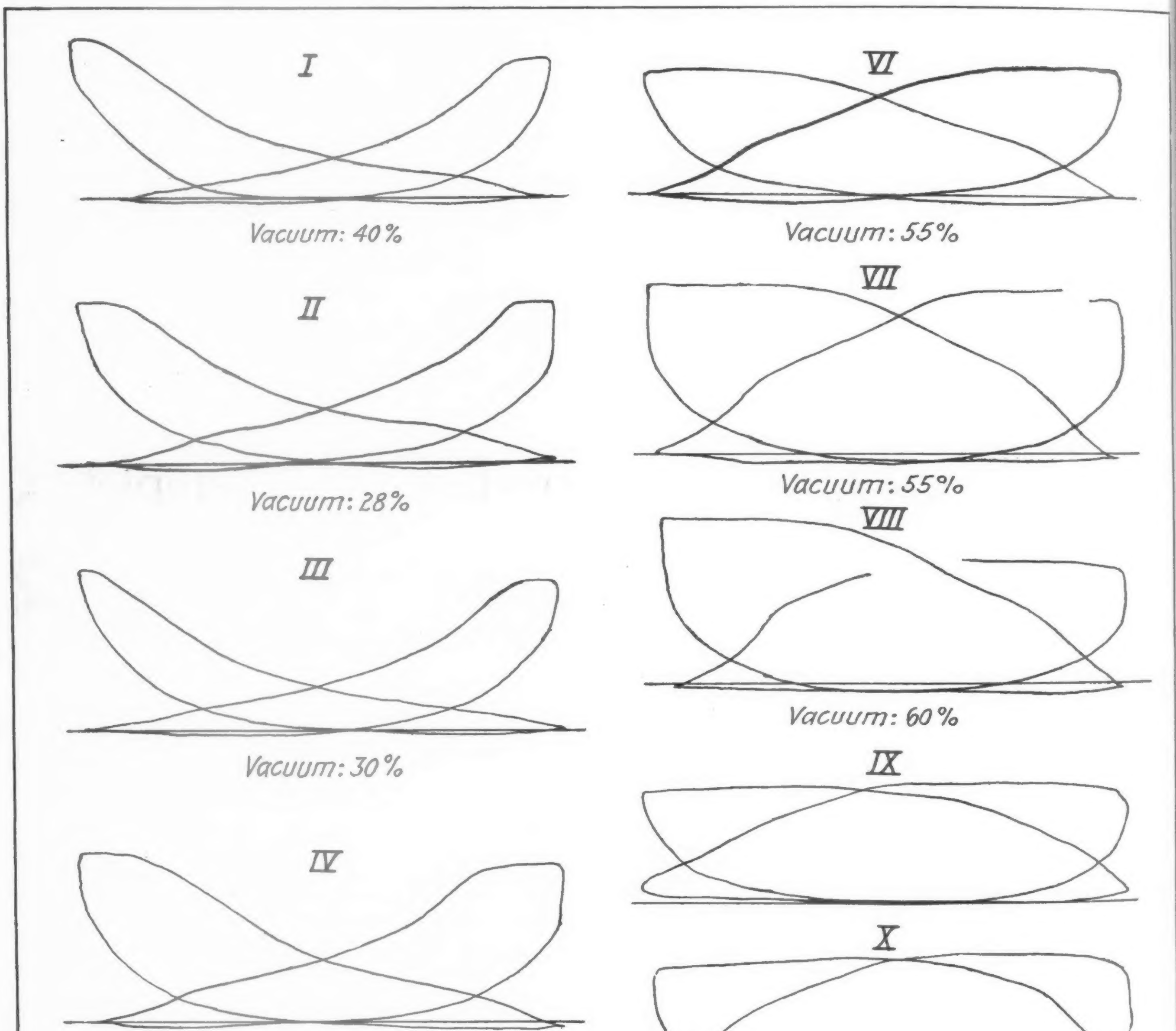


Fig. 1—A Theoretical Indicator Card in Which the Shaded Area Below the Atmospheric Line Shows the Gain in Pressure Energy Exhaust Ejector Action

smoke box, that the fireman carried an unusually light fire, that there was little surplus air and a relatively small amount of carbon monoxide. There was also considerable moist steam at the mouth of the stack which showed that the steam was performing an increased amount of work. This increased work is shown in Fig. 1 by the shaded area below the atmospheric line, which, however, amounts only to 14 per cent of the lost work represented by the shaded area above the atmospheric line. It also showed that the suction exhaust was working with an extremely bad efficiency, which opens the prospect of realizing a much better vacuum if proper measures to that end are taken. In fact a vacuum of 80 per cent should be easily attainable. This design can be improved in a great many ways; for example, the spider placed in the mouth of the nozzle should be removed in order to give more area for the exit of the flue gases.

Construction of the Cylinders

Referring to the sectional drawing of the cylinder it will be noted that the prolongation of the cylinder and piston is



Indicator Cards I to IV Inclusive Are Taken at Low Speeds; V and VI Are Taken at High Speeds and VII and VIII Are Taken at Medium Speeds; Cards IX, X and XI Are Starting Diagrams

remarkably small due to the large advance in the exhaust of 25 per cent, which increases the lost area of the diagram in Fig. 1 to a large extent. The bull ring inserted between the two piston heads carries the piston. No hard bushing is used

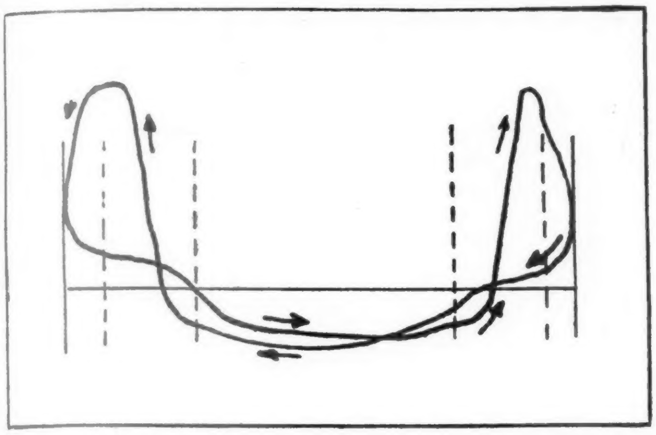


Fig. 2—Indicator Diagram Taken from a Single Exhaust Pipe

in the cylinder itself. The clearance space is 12 per cent, which could be reduced to quite an extent if blowing of the cylinder safety valves is resorted to at very early cut-offs. Referring to the drawing of the indicator cards, a vacuum of from 28 per cent to 40 per cent is obtained at 20 per cent cut-off, thereby compensating for the long compression entailed by the large exhaust lap of the piston valve. At 30 per cent cut-off a vacuum of 40 per cent is obtained, while at 50 per cent cut-off the tests showed from 55 per cent to 60 per cent vacuum. The last three cards shown in the drawing are starting diagrams, taken at 70 per cent cut-off. The time between exhausts is so large that the returning air pressure destroys the vacuum, but it will come up as soon as the speed is increased sufficiently, as is shown in the last card. The speed, of course, is an important factor in this peculiar process of producing a vacuum and obviously a three-cylinder locomotive will be more adaptable to produce a vacuum, which in this case may be termed a mechanical

A general idea of this locomotive may be obtained from the illustrations. It is an 0-10-0 type equipped with a standard Walschaert valve gear, which in this connection has some bad features. In spite of these bad features, however, a considerable saving in steam and coal may be expected.

It is left to the reader to imagine what field is available for the condensing turbine locomotive if there should be a vacuum produced with the unaflow system, for a medium and long cut-off, equal to that of a turbine locomotive equipped with a condensing device. This question may be raised to good advantage, especially in America, where a long cut-off is commonly used.

Air Brake Investigation by I. C. C. Completed

The Adoption of More Complete Specifications for Maintenance and Operation Are Recommended

Early in August the Interstate Commerce Commission made public an opinion in its investigation of "power brakes and appliances for operating power-brake systems."

The opinion, from which three commissioners in part dissented, embodies the following conclusions:

Improvements in the operation of power brakes for both passenger and freight trains are essential and must be effected.

Improvements in power-brake appliances can be made and increased safety in train operation can and must be obtained.

A power-brake system for passenger and freight trains should insure that only a service application of the train brakes will occur when a service reduction of brake-pipe pressure is made.

A power-brake system for passenger and freight trains should provide means whereby effective emergency brake-cylinder pressures will be obtained when an emergency reduction of brake-pipe pressure is made from a fully charged brake system.

A power-brake system for passenger and freight trains should provide means whereby effective emergency brake-cylinder pressures will be obtained when emergency reduction of the brake-pipe pressure is made after a full service brake-pipe reduction has been made.

A power-brake system for passenger and freight trains should provide means whereby effective emergency brake-cylinder pressures will be obtained when an emergency reduction of brake-pipe pressure is made following release after a full service brake application.

A power-brake system for passenger and freight trains should provide means whereby the engineman can control the release of pressure from brake cylinders and effect such release by graduated steps or gradually in order that he may decrease as well as increase brake-cylinder pressures as required to control at relatively uniform rates the speed of trains.

A power-brake system for passenger and freight trains should provide for obtaining and maintaining brake-cylinder pressures within prescribed limits for specified periods of time during brake applications.

In addition to these general requirements it is clear that full specifications and requirements covering more fully the functions, maintenance, and operation of power brakes and appliances should be adopted. Consideration will be given to this and to the form of order to be issued by us. This case will be held open for that purpose.

This investigation has been under way since February, 1922, and was instigated on the petition of the Automatic Straight Air Brake Company. On March 24, 1922, a questionnaire was sent out calling on 196 carriers to furnish certain information relative to rules and practices in the use of hand brakes, the number of accidents resulting from failure promptly to control the speed of trains on grades and other related information.

It appeared that on 25 railroads hand brakes were used to control the speed of freight trains, or to supplement the power brakes in controlling the speed of such trains, not only on 122 grades for which specific data were furnished, but also on numerous branch lines. On 169 other railroads reporting a total of 1,807 grades, the speed of trains was controlled exclusively by power brakes. The information furnished under this head covered a total of 1,929 grades of 1 per cent or more having a length of 3 miles or more. In many cases the grades on which hand-brake operation was reported were less severe, both in percentage of gradient and length, than grades upon which trains were controlled entirely by means of power brakes. During the three-year period 1919-1921, inclusive; there occurred on these 1,929 grades 67 accidents, each of which resulted in personal injury or property loss of $500 or more, caused by failure properly to control the speed of trains. These accidents caused the death of 15 persons, the injury of 46 persons, and a property loss of $432,908. During the year 1921 the accidents attributed

to specific causes mentioned in our questionnaire numbered 1,336. These accidents caused the death of 19 persons, the injury of 1,305 persons, and entailed a property loss of $343,654.

History of Air Brake Development

The opinion of the commission follows the detailing of these facts with a history of the development of the air brake since 1870, including an outline of the work done by the Master Car Builders' Association and the present American Railway Association. Following a description of the evolution of the Westinghouse and New York Air Brake systems, the commission's report outlines the development of the Automatic Straight Air Brake Company's triple valve with particular and detailed reference to the rack tests and then the road tests on the Norfolk & Western.

At the hearings held in connection with this investigation, the Automatic Straight Air Brake Company presented evidence to show that certain defects were present in the power-brake devices in common use; also evidence of the developments, installations and services of the A. S. A. brake. It contended that the more general use of these devices would afford freedom from a number of troubles now commonly encountered and result in material improvement in power-brake operation.

Contend A. S. A. Brake Experimental

Other parties appearing at the hearings contended that the A. S. A. brake devices were still in an experimental stage; that service tests to which they had been subjected had not been sufficiently extensive to warrant final conclusions and that the demonstrations on the Norfolk & Western in 1921 were conducted under favorable conditions that did not represent the usual service conditions encountered on long trains of empty cars or with a leakage such as commonly exists.

After the hearing had been completed, in order to determine certain questions which conflicting evidence had introduced, the hearing was reopened April 27, 1923, for the purpose of a test by the I. C. C. Bureau of Safety of the Automatic Straight Air Brake equipment on the Norfolk & Western.

An abstract of the report on these tests as submitted by W. P. Borland, director of the Bureau of Safety, appeared in the *Railway Age* of March 1, 1924, page 500. Issue was taken with Mr. Borland's findings by various railway executives and their testimony will likewise be found in the *Railway Age* of March 8.

The tests on the Norfolk & Western were also observed by a committee of railway representatives headed by C. E. Chambers, superintendent of motive power of the Central of New Jersey and chairman of the Committee on Safety Appliances of the American Railway Association, Mechanical Division. The findings of this committee were considerably at variance with those of Mr. Borland. The commission's opinion discusses the points at issue and in general approves the findings of its own representatives.

Dissenting Opinion

Commissioner McManamy dissented from the majority opinion in part and discussed the report as follows:

The conclusions of the majority in this case are directed towards the accomplishment of two definite purposes, (*a*) better maintenance of existing power-brake systems, and (*b*) fundamental changes in the design of power-brake systems to make possible additional functions.

I am in full accord with the conclusion requiring better maintenance. The evidence abundantly shows the need for better maintenance of power-brake systems and the improved performance which will result therefrom. No witness, either for carriers, the brake manufacturers, or the employees, testified that power-brake systems as a whole were maintained in an efficient or satisfactory operating condition. On the contrary, every witness testified that improved performance would result from better maintenance and that such better maintenance should be required. I am not in agreement, however, with the conclusions which require changes in the design of power-brake systems in order to make possible the performance of additional functions not now included in existing standard freight brakes, because (1) the record does not show that the existing power-brake systems if properly maintained are inadequate to safely control trains; (2) if existing brake systems are adequate, I question our authority to require the use of improved devices; and (3) the investigations and tests are insufficient, to my mind, to definitely show that the proposed changes in design can be made without introducing undesirable features which will offset any benefits which may be derived therefrom.

In my opinion the basic question presented in this proceeding is: When properly maintained are existing power-brake systems adequate to safely control trains under present operating conditions? If we find in the affirmative, we should prescribe and enforce standards of maintenance that will insure proper performance and maximum efficiency of existing power-brake systems. In my opinion it has not been shown that present brake systems are inadequate; therefore a further question arises. If existing systems are adequate to safely and efficiently control trains, and if improved devices are available which are not being used, have we authority, in addition to requiring better maintenance of the power-brake systems in use, to also prescribe specifications and requirements which will compel the use of such improved devices? I question that section 26 of the act, under which this proceeding is brought, gives us such authority.

No Evidence Showing Brakes Inadequate

The outstanding feature of this case, to my mind, is the fact that the record is barren of evidence that the existing power-brake systems, when properly maintained are inadequate to safely and efficiently control trains under present-day operating conditions. This statement is supported by the majority report. For instance, the following appears in the report:

> Officials who are directly in charge of air-brake inspection and maintenance, and instruction of employees in air-brake operation on the lines of several of the carriers, testified in this proceeding. It was the consensus of opinion of these witnesses that the present freight brake equipment with K-type triple valves now generally in use is adequate and in accordance with the requirements of safety when properly maintained. With reference to improvements in power-brake appliances, the principal suggestion offered was that efforts to improve conditions of maintenance should be continued.

Efforts to improve power-brake systems should, without doubt, be diligently continued, and where it can be definitely shown that improvements in design have been made which would increase the safety of operation, such improvements should be incorporated in the existing power-brake systems. But, to my mind, the evidence in this case has fallen short of showing that improvements are available which do not, at the same time, possess undesirable features sufficient to counteract the good effects hoped for, thus leaving no net gain.

While the conclusions of the majority are stated in general terms and without reference to any particular type of brake, the report throughout is based upon a comparative test of the automatic straight air brake, in which all of the features recommended are said to be incorporated, and the Westinghouse brake, the one in general use. The additional features are not used on the latter, because they are said to be undesirable. It is unfair to select specific brake applications and attempt to base a conclusion thereon as to the relative merit of different power-brake systems. This was the principal cause for the disagreement between observers at the Norfolk & Western tests.

Viewing the situation in its broadest light, the present power-brake system has been in general use for more than half a century and from time to time changes and improvements have been made. It is in service on 2,500,000 cars and locomotives. The uncontradicted testimony of carriers' witnesses is that when properly maintained it safely and efficiently performs the required functions. This testimony is from representatives of railroads that are safely and satisfactorily controlling by means of power brakes heavy passenger and freight trains on the steepest mountain grades in the country. In view of this testimony we can not find that standard power-brake systems, properly maintained, do not meet every requirement of the law. On the other hand, the record shows that the other brake system has placed in service during the past few years only 199 brakes on four different railroads. Of these, 140 are on freight and 59 on passenger cars. The only information available respecting the performance of these brakes has been developed during the past two or three years and, in so far as the emergency features are concerned, is limited almost entirely to that resulting from the Norfolk & Western and Virginian tests. To my mind these tests alone are insufficient to form the basis of an order directing fundamental changes in the design of power-brake systems. If, based on these tests, we find that certain additional functions, such as emergency following release, emergency following service, or the ability to graduate brakes on or off can be performed, we must at the same time give consideration to the un-

desirable performances, which admittedly occurred during these tests, resulting from the changes in design. Among these are the effect of leakage variation in piston travel and the slowing up of serial action which are referred to in the report.

Satisfactory Braking for 100-Car Trains

Quick serial action of brakes required 30 years to develop to a point where it is possible to obtain satisfactory brake performance on 100-car freight trains. Briefly, it means that the action of the brakes throughout the train must be quicker than the action of the slack in the train. That is, the brake on each car must respond so quickly that each car will be stopped by its own brake and not by striking the car ahead. The tests show that substantially more time was required to apply the A. S. A. brakes on 100-car trains than to apply the standard brakes. This necessarily results in greater shocks and in greater damage. To my mind, the ability to make smooth stops is more important in freight-train braking than the ability to make quicker stops, and the testimony is uncontradicted that the shocks resulting from the emergency application of the A. S. A. brakes on the test trains were severe.

The testimony is conflicting as to whether or not the shocks were more severe than on similar trains equipped with standard brakes, and no tests were made to determine this point.

If the additional features to be incorporated will increase the severity of the shocks on long freight trains, which are at present a serious source of danger to train crews, it may well be that freight-train braking would be safer and more satisfactory without such a feature. It is well recognized that greater property damage and more personal injuries result from rough freight-train stops than from failure to get emergency action following release or following service.

The additional increased safety in mountain braking which comes from the additional supply of air carried on each vehicle with the A. S. A. brake is a factor which may well be given consideration, but the performance of the test trains did not afford opportunities for demonstrating what value this would be in an emergency.

For the above reasons I can not join with the majority in the conclusion that we should order fundamental changes in brake designs as stated in their report, without further evidence (1) of the need for such additional features and (2) of the possibility of their satisfactory performance. I believe, however, that further trial of these changes in design should be encouraged in every proper way.

I am authorized to state that Commissioners Eastman and Potter join in this expression.

Locomotive Resistance and Tractive Force

Machinery Losses Are Considered in Calculating the Resistance in Terms of Mechanical Efficiency

By Kiichi Asakura

Mechanical Engineer, Japanese Government Railways, Tokio, Japan

IN an article on locomotive resistance and mechanical efficiency, published in the July 30, 1921, issue of the Railway Age, the writer stated that locomotive resistance is better expressed as a function of mechanical efficiency rather than in the usual form of pounds per ton of the total adhesive weight of the locomotive. This conclusion had been deduced from the results of several locomotive tests which were then available. However, a locomotive consists of a steam engine which is subject to steam losses. It is more than a steam engine, however, in that it is mounted upon a running gear which is also subjected to all the losses incident to any unit of rolling stock. A total of these losses constitutes what is defined as locomotive resistance and is understood to be a combination of the losses from the two sources just referred to.

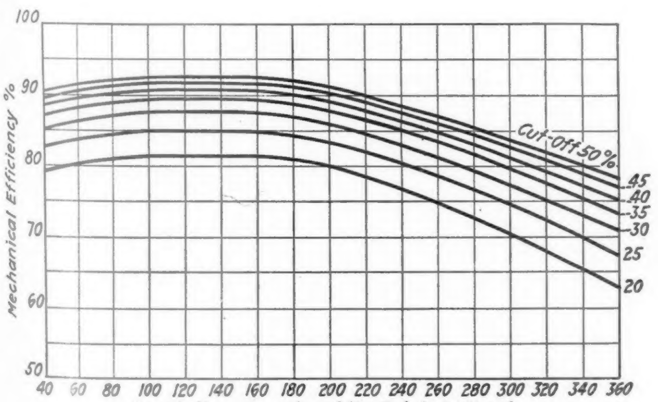


Fig. 1—Curves Plotted from the Results Obtained from the Formulas for Mechanical Efficiency

The latter are caused by such items as journal resistance and rolling friction which are affected by the weight of the locomotive. These may be equitably considered as proportional to the weight and it therefore becomes quite rational to express such resistance in terms of so many pounds per ton of locomotive weight. The kind of resistance thus covered is that which is developed by the locomotive as a unit of rolling stock and since it is caused by friction, it may and will be referred to herein as the rolling stock frictional resistance. This, together with the rolling stock air resistance, may be likewise termed the rolling stock resistance of the locomotive.

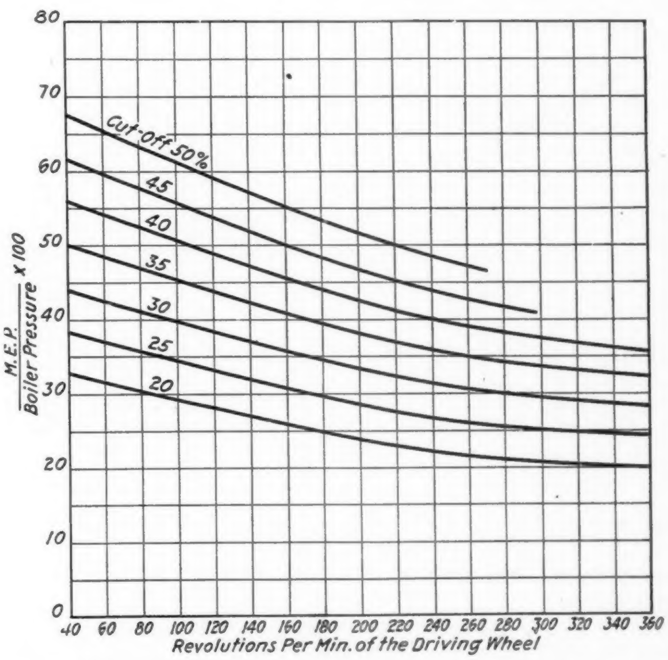


Fig. 2—Relation of the Ratio of the Mean Effective Pressure and the Boiler Pressure to Revolutions of the Driving Wheel

Steam engine losses are the greater and may be referred to as the engine resistance of the locomotive. Since the pres-

sure of steam in the cylinder is the source of the engine resistance and at the same time the source of the power developed, it should be quite reasonable to express engine resistance in terms of mechanical efficiency. Engine resistance and indicated horse power are functions of cut-off and of the driving wheels. The formula is plotted in curves as shown in Fig. 1.

For the development of these formulas, the engine resistance was calculated from the experimental data previously mentioned by subtracting the rolling stock frictional re-

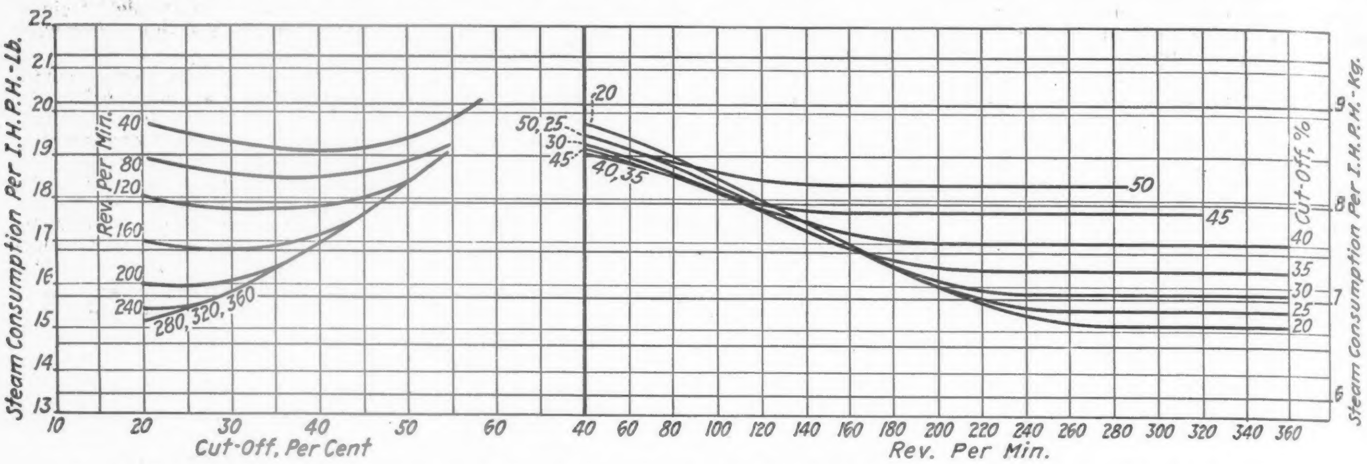


Fig. 3—Relation of Steam Consumption Per I. H. P. to the Per Cent Cut-Off and Driving Wheel Revolutions Per Minute

number of revolutions of the driving wheels. Therefore mechanical efficiency is expressed with reference to such terms. We can find no such reasons which will justify the thought that engine resistance is proportional to the total or adhesive weight of the locomotive. Nor do any experimental results support this idea.

Locomotive Resistance

In the article on locomotive resistance and mechanical efficiency a formula was developed for the expression of mechanical efficiency. Since, however, locomotive resistance consists of the two distinct factors referred to, namely, the rolling stock resistance and the engine resistance, and since the latter is only to be expressed as a function of mechanical efficiency, the formula must undergo some alteration. From the same data which was used in the former article, a

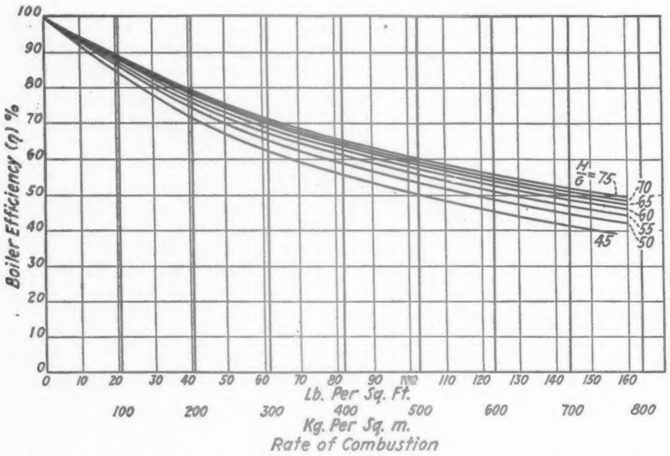


Fig. 4—Relation of Boiler Efficiency to the Rate of Combustion

new formula for mechanical efficiency has been developed as follows:

$$E = 100 - \sqrt{\left(\frac{370}{c}\right)^2 + \frac{0.47}{c}(100 - n)^2} \quad \ldots\ldots\ldots\ldots\ldots \quad n < 100$$

$$E = 100 - \frac{370}{c} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad 100 \leq n \leq 150$$

$$E = 100 - \sqrt{\left(\frac{370}{c}\right)^2 + \frac{0.47}{c}(n - 150)^2} \quad \ldots\ldots\ldots\ldots\ldots \quad n > 150$$

where E is the mechanical efficiency, c is the cut-off in per cent and n is the number of revolutions per minute of the driving wheels.

sistance which was estimated by the following formula:

w = 2.2 0.015 v kg. per metric ton,
where v is the speed in km. per hour.

or nearly

w = 5 0.054 V lb. per long ton,
where V is the speed in miles per hour.

This gives about the same values as those given by Frank's formula, although his formula involves the terms v instead of v^2.

Mean Effective Pressure and Steam Consumption

To calculate the tractive effort of a locomotive by applying the mechanical efficiency, it is necessary to determine the

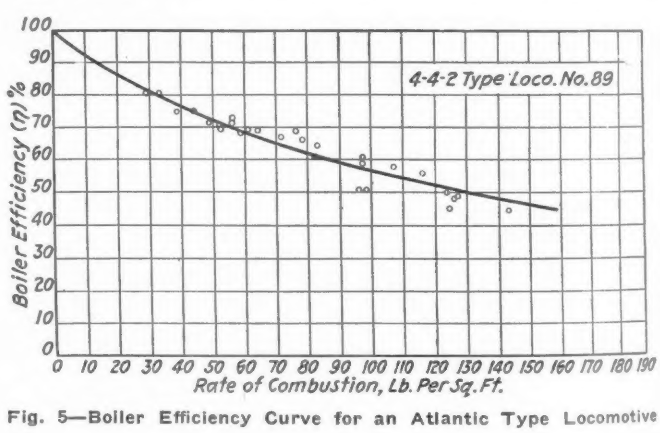


Fig. 5—Boiler Efficiency Curve for an Atlantic Type Locomotive

mean effective pressure and the steam consumption with reference to cut-off and the number of revolutions of the driving wheels.

From the test results which form the basis of this investigation, the mean effective pressures, expressed in the form of ratios to the boiler pressure, correspond to several cut-offs and to succeeding increasing driving wheel revolutions per minute. These are represented by fair curves in Fig. 2.

Similarly the curve of the steam consumption per indicated horse power hour correspond to several cut-offs and to a succeeding greater number of driving wheel revolutions which are shown in Fig. 3. The test results pertaining to steam consumption did not in themselves locate very clearly the steam consumption curves, but a comparative study of all the curves drawn for each set of conditions seemed to consistently support the arrangement of such curves as shown in Fig.

3. They are applicable only for superheated steam locomotives because all of the data used was obtained from the locomotives which were superheated.

Evaporative Power of the Boiler

The evaporative power of the boiler is also required for the calculation of the tractive force. Though there are several formulæ pertaining to the evaporation of locomotive boilers, such as those of Köchy, Strahl and Goss, the author

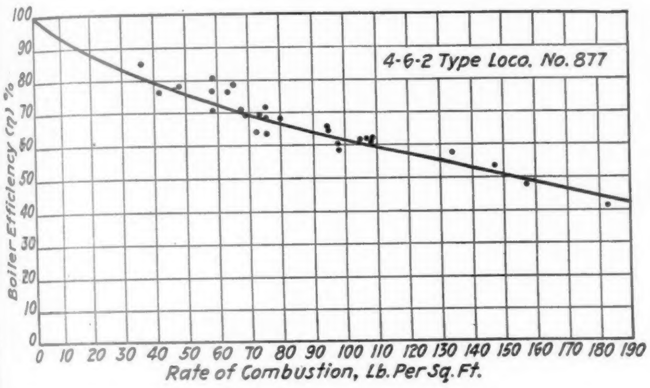


Fig. 6—Boiler Efficiency Curve for a Pacific Type Locomotive

is of the opinion, that the following theoretical formula constitutes a better expression for it:

$$Q = \frac{B\,G\,W\,Z}{h}$$

where Q = the evaporation per hour,
B = the rate of combustion,
G = the grate area,
W = the heat value of the coal used,
Z = the boiler efficiency,
h = the heat quantity required for the production of a unit weight of steam.

To ascertain the boiler efficiency, results from the Pennsylvania Railroad testing plant, Altoona, Pa., were plotted with reference to the rate of combustion and an empirical formula was developed as follows:

$$Z = \frac{1}{1 + B\left(0.0012 + 3{,}300\left(\frac{G_4}{H}\right)\right)}$$

where B is expressed in kg. per sq. meter.

$$Z = \frac{1}{1 + B'\left(0.006 + 16{,}000\left(\frac{G_4}{H}\right)\right)}$$

where B′ is expressed in lbs. per sq. ft.

General curves of the boiler efficiency were plotted from the above formula and are shown in Fig. 4. In the case of some of the locomotives tested at Altoona the boiler efficiencies calculated by these formulas are shown by curves in Figs. 5 to 7 together with the test results actually obtained, which are also plotted. These formulas for boiler efficiencies are also applicable to superheated steam locomotives.

Boiler efficiencies of saturated steam locomotive boilers can be obtained from these formulæ under the following assumptions: First, that the heat transmitted through the superheater heating surface is about 10 per cent of the total heat transmitted through the total heating surface. This assumption may also be justified from the Altoona testing plant results. Second, the superheater heating surface is about 30 per cent of the evaporative heating surface. This may be safely assumed as the common practice in up-to-date locomotive construction. The formula then becomes

$$Z = \frac{1}{1 + B\left(0.0012 + 1{,}750\left(\frac{G_4}{H}\right)\right)}$$

Where B is expressed in kg. per sq. meter.

The boiler efficiencies of the consolidation type locomotives tested at Illinois University is somewhat lower than that represented by this formula. While those of the American type locomotive tested by Sanzin of the Austrian Railways are higher, indicating therefor the equity of the author's faith in these boiler efficiency formula.

Tractive Force

The tractive force of a locomotive at slow speed is limited by the adhesive weight or by the maximum cylinder tractive effort. It is also limited by the boiler capacity when the speed is increased beyond a certain limit. The tractive force here considered is limited only by the latter conditions. Since the mean effective pressure may be determined when the speed and cut-off are known, the indicated horse power corresponding to various cut-offs can be calculated for any speed. The steam consumption per indicated horse power hour being also known or determinable, the total steam consumption corresponding to various cut-offs and speeds can also be calculated. On the other hand, the total evaporation of the boiler may be found from the formula given above, so that the longest cut-off for which the boiler capacity is able to meet the demands for steam at the various speeds may be determined. The mean effective pressure may be determined for each speed and for the longest cut-off, for which the boiler can supply the necessary steam, and the indicated tractive force may be calculated. This indicated tractive force multiplied by the mechanical efficiency corresponding to the speed and the cut-off, is the effective tractive force for the given speed. Then, by subtracting the rolling stock resistance from the effective tractive force, we may obtain the tractive force available at the drawbar.

The Computing Chart

The calculation of the tractive force according to the methods explained in the preceding paragraph is rather

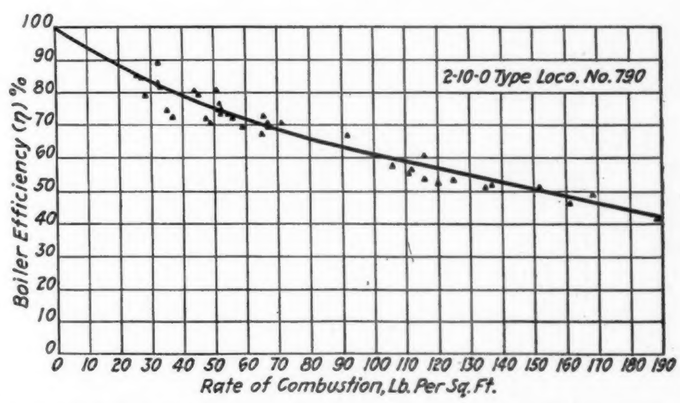


Fig. 7—Boiler Efficiency Curve for a Decapod Type Locomotive

tedious, but by the aid of the computing chart as shown in Fig. 8, the effective tractive force of superheated steam locomotives may be easily obtained with a minimum amount of calculation. The chart is based upon a combustion rate of 113 lb. per sq. ft. of grate area and coal of 12,600 B.T.U. per lb. To use this chart the following constants should be calculated for the particular locomotive under consideration:

$$\frac{\text{Grate area sq. ft. or sq. in.}}{\text{Cylinder volume (one cyl. cu. ft. or cu. in.)}} = \frac{G}{J}$$

$$\frac{\text{Total heating surface (fire side)}}{\text{Grate area}} \ldots\ldots\ldots\ldots = \frac{H}{G}$$

$$\frac{\text{Cylinder dia. in.} \times \text{stroke, ft. or in.}}{\text{Dia. of driver, ft.}} \ldots\ldots\ldots = \frac{d^2 l}{D}$$

The method of procedure is as follows: Locate the value of G/J on the horizontal scale of the chart. Follow upwards along the vertical line representing the value of G/J, until

the line which represents the proper H/G ratio is intersected. Now consider a horizontal line drawn through the point at intersection just located. Locate the intersection of this horizontal line with the line which represents, in the lower portion of the chart, the proper value of n. Trace the vertical line passing through this intersection point upwards until the proper n line of the same value is again encountered in the upper portion of the chart. Follow the horizontal line through the point of intersection last located to the point where the proper $\frac{d^2 1}{D}$ line is cut and read from the scale at the top of the chart the desired effective tractive force. This will apply to the value of n which has been selected and used. The effective tractive force may likewise be obtained for as many other values of n as the various purposes to be served may require.

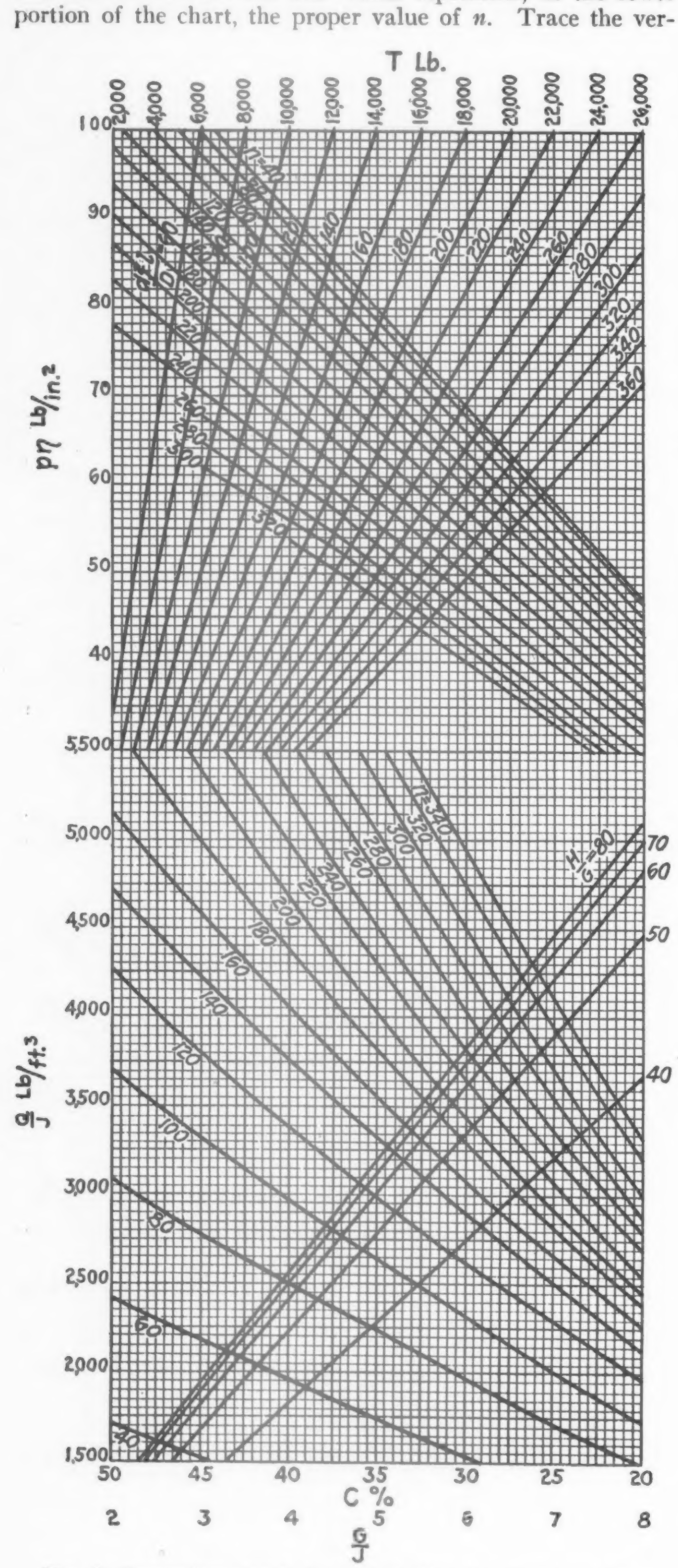


Fig. 8—Computing Chart for Calculating the Tractive Force

An example showing the application of the chart is given as follows: It is desired to find the tractive force of the following two locomotives, namely, a 4-4-2 and 2-8-2 type similar to the E6s and L1s classes of the Pennsylvania Railroad respectively. The necessary data is listed as follows:

Cylinder	23½ in. x 30 in.	27 in. x 30 in.
Diameter of driving wheel	80 in.	62 in.
Boiler pressure, lb. sq. in.	205	205
Grate area, sq. ft.	55.70	70
Total heating surface, sq. ft.	3,406	4,848
Adhesive weight, lb.	133,100	235,800
Total weight, lb.	240,000	315,600
G/J	7.42	7.05
H/G	61.0	69.1
$d^2 1/D$	207	365

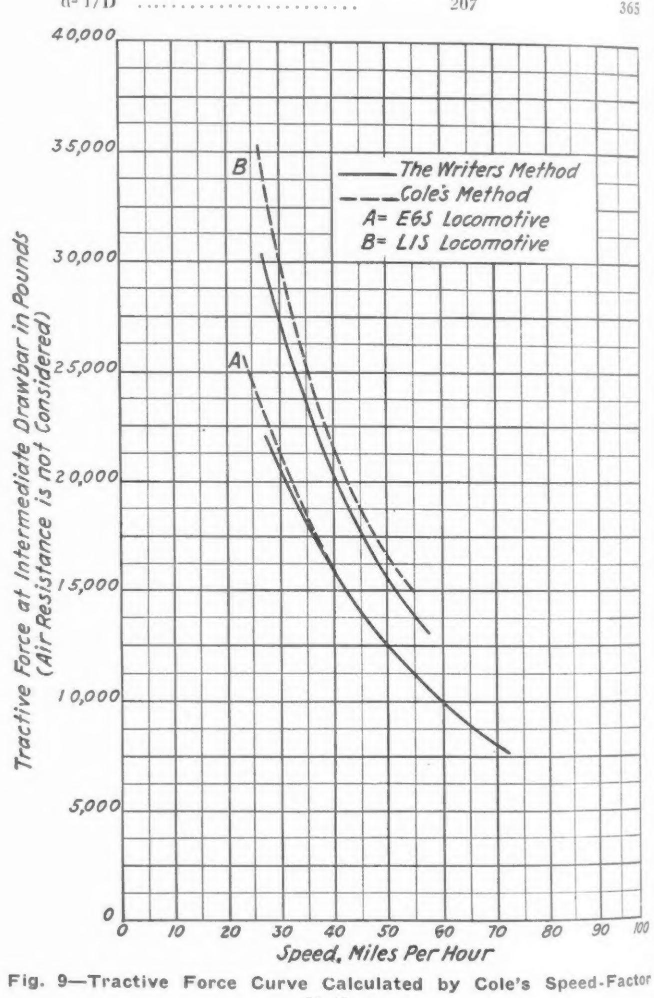


Fig. 9—Tractive Force Curve Calculated by Cole's Speed-Factor Method

We have determined from the chart as the effective tractive force at various speeds, the following values:

n	E6s	L1s
140	19,600	.....
180	15,600	26,000
220	12,800	21,600
260	10,500	18,000
300	8,800	15,000

The tractive force can be obtained by subtracting the rolling stock frictional resistance calculated by the formula given in a preceding paragraph from the above effective efforts. These results are shown as follows:

	Class E6s			L1s		
Revolutions per min.	Effective tractive force	Rolling stock frictional resistance	Tractive force at (a)	Effective tractive force	Rolling stock frictional resistance	Tractive force at (a)
140	19,600	730	18,870	.....	....	.....
180	15,600	780	14,820	26,000	960	25,040
220	12,800	840	11,960	21,000	1,010	19,990
260	10,500	890	9,610	18,000	1,070	16,930
300	8,800	950	7,850	15,000	1,120	13,880

The tractive efforts of the two locomotives were also calculated by Cole's speed-factor method and the results were plotted in Fig. 9. The boiler of the L1s locomotive is of 96 per cent capacity according to the the grate area formula used by the American Locomotive Company. However, the calculations represented in Fig. 9 were made upon the assumption that the boiler was of 100 per cent capacity. Comparing the curves, we find that the tractive force calculated from the computing chart are somewhat lower than those given by the speed-factor method in case of the L1s locomotive, while they practically coincide in case of the E6s locomotive.

From the theoretical point of view there ought to be some differences between the tractive force calculated by the two methods. According to the practice of the American Locomotive Company, the rate of combustion is assumed to be 120 lb. per sq. ft. per hour, and the heat value of the coal is taken as 14,000 B.T.U. per lb., while, in the arrangement of the computing chart, both these factors were assigned smaller values.

Conclusion

In the preceding paragraphs it is stated that the locomotive resistance should be partly represented as so many pounds per ton weight and partly as a function of the mechanical efficiency. The formula for mechanical efficiency was developed and a method of calculating the tractive effort by applying the mechanical efficiency was also explained. The results of the calculation according to this method are nearly equal to those calculated by the speed-factor method. From a theoretical point of view, the method of expressing the engine resistance as a function of mechanical efficiency is correct. Moreover, this method of calculation of tractive effort can be applied to a locomotive whose boiler capacity is less than 100 per cent. This is important, because many locomotives have boiler capacities less than 100 per cent.

Apprenticeship Methods on the Santa Fe*

Boys Protected Against Personal Prejudice; Wholesome Activities Outside the Shop Are Promoted

Part IV

EACH shop on the Santa Fe has what is known as an "Apprentice Board," a committee composed of the general foreman as chairman, the foreman under whom the apprentices work, the apprentice shop instructor, and the apprentice school instructor. This board meets once each month, on a stipulated day and hour, and passes on the fitness of all apprentices and on questions pertaining to the training and handling of apprentices. The fitness of each apprentice is discussed at least once each month during the boy's probationary period, once each six months thereafter, and oftener as occasion arises.

Apprentice School Record

Location .... Trade .... Name ....

19	Service in Hours	Hours Attended School			Drawings		Mathematics		Miscellaneous	Instr'ctr's Initials
		During Month	During Apprenticeship	Std. Rqmts.	Std. Rqmts.	Comp.	Std. Rqmts.	Completed	Kind of work	
Jan										
Feb										
March										
April										
May										
June										
July										
Aug										
Sept.										
Oct.										
Nov.										
Dec.										

This record to be mailed to Supervisor of Apprentices on 10th of each month.

When an apprentice is graduated or leaves the service, make notation hereon, and mail this record at once with letter giving full particulars.

Form of the Monthly Report of School Work

Functions of the Apprentice Board

This board is a live, active body, anxious to deal out real justice to all apprentices. Each member has the same authority and each shows the same spirit of fairness and willingness to give each apprentice the best chance or opportunity possible. The personal prejudice of one man or one member of the board is of little consequence, for all members are anxious that each boy, however poor and friendless, be given full justice. Sometimes the board recommends a further trial of a few months. Sometimes it recommends a transfer to some other trade or a different line of work. Sometimes it recommends dismissal. If the board decides that the boy, instead of being fitted to become a mechanic, should be a lawyer, a doctor, or a merchant, the boy is kindly told that he is wasting his time by remaining in the shop, but in such dismissal the boy knows, his parents know, his friends know, and the shop management knows that the partiality or dislike of no one man was responsible for this action.

If the apprentice appears capable of development, but is not taking advantage of his opportunities and not applying himself as he should, he is called before the board, told of his shortcomings, and what is expected of him. If the board finds that the apprentice has not been given sufficient opportunity to prove his fitness, or is not being given a sufficient variety of experience, arrangements are made then and there to change his assignment of work, and give him the needed experience. Sometimes it is advisable to change the boy to a different department of the shop, under a different foreman.

The board is free to discuss any subject pertaining to apprentices. Report of the board's findings and recommendations is made to local authorities and a copy is sent to the supervisor of apprentices. These apprentice board meetings not only guarantee fair treatment and thorough experience for all apprentices, and the weeding out of the unfit, but result in closer co-operation between instructors and foremen, and aid materially in the training of apprentices. Since foremen as well as instructors know they are to be called upon to pass on each apprentice in their charge, they naturally observe the work of these apprentices more closely, studying their strong and weak points and becoming more intensely interested in their welfare. No one feature of the apprentice training system of the Santa Fe is productive of more wholesome results than the proper functioning of these apprentice boards.

Annual Convention of Apprentice Instructors

The general plan of apprentice instruction is uniform at all points on the system. All lesson sheets and supplies and

*This is the concluding article of a series of four describing the details of the apprenticeship methods followed on the Atchison, Topeka & Santa Fe.

instructions pertaining to apprentices are issued through the office of the supervisor of apprentices. In addition to meetings of apprentice boards and frequent conferences of local instructors, all instructors of the system are assembled once each year for a three-day discussion of matters pertaining to the training and development of apprentices. A few officers from other departments, and one or two speakers of national repute, address the instructors at these meetings, but the program of the convention as a whole consists of discussions by the instructors themselves. They talk shop, compare notes and under the guidance of the supervisor of apprentices, study and plan ways and methods of making the apprenticeship work more efficient, more beneficial to the apprentices, and to the company.

By rotating the place of holding these meetings, the instructors are given the opportunity to become familiar with conditions and equipment and methods at different shops and to profit by the methods used by others in similar work. The annual meeting this year was held at Albuquerque, New Mexico, where the newest and most up-to-date shops of the road are located.

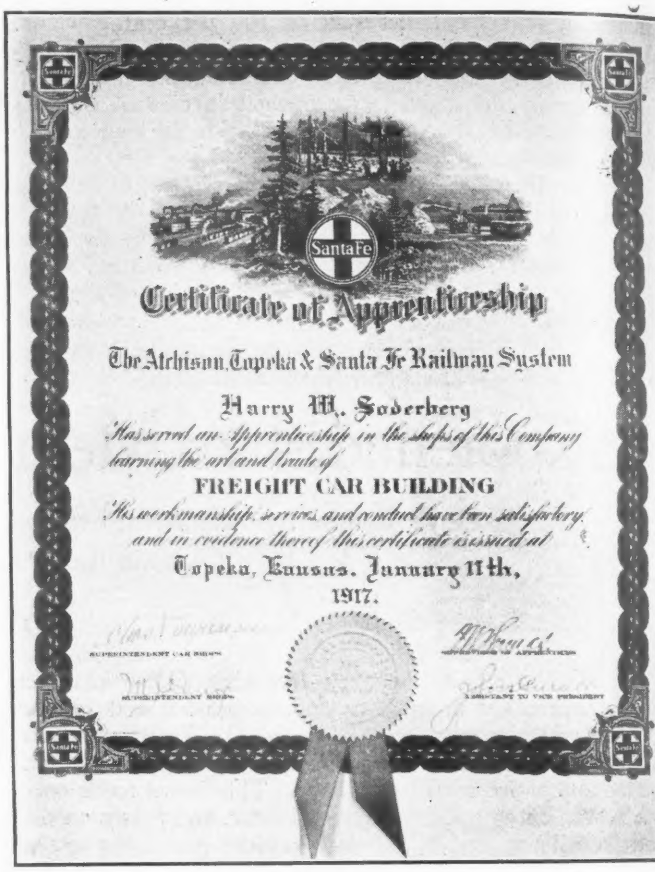
Records of Apprentices and Graduates

A complete record is kept of each apprentice and apprentice graduate. Throughout the four years of apprenticeship the supervisor of apprentices receives monthly reports and maintains in his office records showing the number of hours each apprentice attends school, the number of drawings and problems completed, and what work he has done in the shop. At stated intervals the school and shop instructors are required to fill out a blank showing the personal characteristics of each apprentice. This blank contains 28 subjects on which the instructor must grade each apprentice as being very good, good, medium, or poor. Among the personal characteristics thus considered are his honesty, morality, tact, resourcefulness, foresight, promptness, energy, industry, initiative, persistence, accuracy, appearance, personality, loyalty, executive ability, popularity with authorities and with associates, and other traits indicative of his ability or fitness for promotion. This report contains information of inestimable value, but best of all it makes those furnishing the report study the personal characteristics of these young men most carefully, thereby becoming familiar with their talents and possibilities.

In addition to records of apprentices, a complete record is kept of each graduate, showing the various places he has worked, the positions held, the satisfaction given, and other matters of interest in passing on his placement or promotion.

Diplomas Furnished Graduates

Upon graduation, the apprentice is given a handsome diploma showing that he has served an apprenticeship in his trade in the shops of the company, that he has attended the apprentice school regularly and has completed the required work, and that he has become a skilled mechanic. This diploma is signed by the master mechanic or superintendent of shops, the mechanical superintendent, the supervisor of apprentices, and the assistant to the vice-president in charge of mechanical operation.



Santa Fe

Certificate of Apprenticeship

The Atchison, Topeka & Santa Fe Railway System

Harry W. Soderberg

Has served an Apprenticeship in the shops of this Company learning the art and trade of

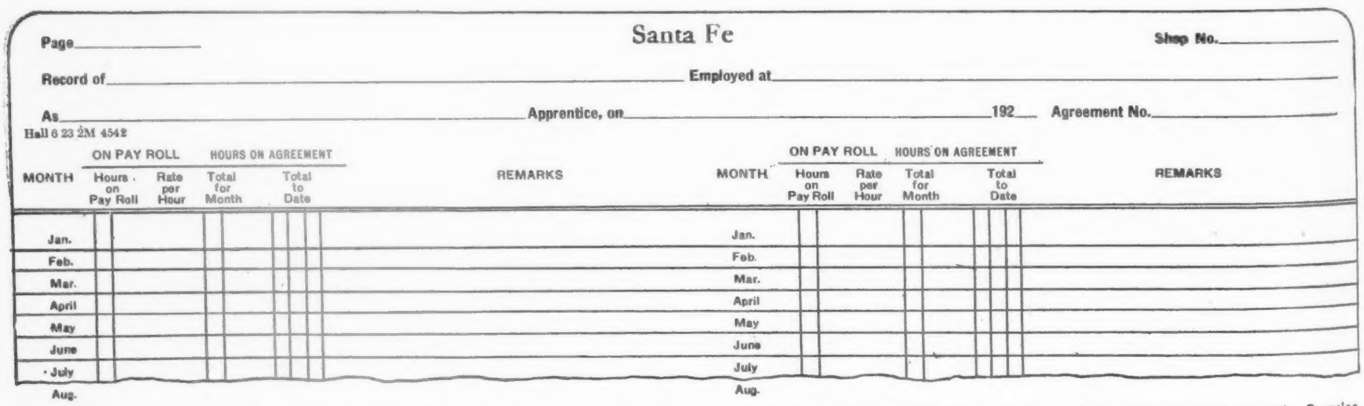
FREIGHT CAR BUILDING

His workmanship, services and conduct have been satisfactory, and in evidence thereof this certificate is issued at

Topeka, Kansas, January 11th, 1917.

Diploma Awarded Freight Carman Apprentices

The apprentice graduate is also given the full journeyman rate of his craft and is given seniority rights from the date of the completion of the first six months, or probationary period, of his apprenticeship. Very few apprentices leave the service upon graduation. There is no reason for their doing so. If they wish to work elsewhere, transfer can generally be arranged to the point at which they desire to work. No other road could treat them better or offer them greater opportunities than are offered them by the road where they served their apprenticeship. The majority realize this and



Page______ Santa Fe Shop No.______

Record of______ Employed at______

As______ Apprentice, on______ 192__ Agreement No.______

Hall 6 23 2M 4542

MONTH	On Pay Roll: Hours on Pay Roll	On Pay Roll: Rate per Hour	Hours on Agreement: Total for Month	Hours on Agreement: Total to Date	REMARKS	MONTH	On Pay Roll: Hours on Pay Roll	On Pay Roll: Rate per Hour	Hours on Agreement: Total for Month	Hours on Agreement: Total to Date	REMARKS
Jan.						Jan.					
Feb.						Feb.					
Mar.						Mar.					
April						April					
May						May					
June						June					
July						July					
Aug.						Aug.					

Card Record Maintained in the Office of Supervisor of Apprentices for Each Apprentice, Showing a Complete Transcript of His Service, Including Transfers

have stayed with the road which gave them their training. Those who have left the service have made good elsewhere, many holding official positions. At least half a dozen have

A Championship Apprentice Football Team

organized and are now in charge of similar apprenticeship systems on other railroads.

Apprentices Supplied with Tools

No apprentice is hampered nor is his work delayed through lack of shop tools. From the start each is provided with a uniform set of first class hand tools consisting of everything

The Fred C. Fox Trophy Presented by the General Manager to the Best Apprentice Baseball Team and the Winners, The Topeka Team, 1924

he will need in connection with his work. These tools are sold to apprentices at wholesale prices and on small monthly payments, the company furnishes each apprentice a neat, substantial tool box for their safekeeping. All defective tools are replaced free of charge.

Discipline of Apprentices

Apprentices work under the same rules as other employees of the shop. The general treatment of apprentices on the Santa Fe is a wholesome one—a mixture of parental and military treatment. It is desired that they have the very best time possible while serving their apprenticeship. No one is allowed to swear at an apprentice or in any way to abuse or mistreat him. The apprentice is never used as a matter of convenience nor in any sense as a helper in the shop. He is taught from the very beginning that his trade is the very best possible occupation for him, that he could not have selected any other work for which he is better suited, or which would bring him greater returns. In brief, effort is made to make him happy and contented in his work and loyal to the company giving him his training. The instructors get very close to their apprentices, winning their confidence, and by virtue of their friendship and intimate relations exert a wholesome influence on their conduct both in and out of the shop. It is aimed to make these young men not only first class mechanics but also men of high moral character—upright citizens whose lives will be a blessing to those with whom they come in contact.

Apprentice Clubs

At most points on the system, apprentice clubs have been organized by the apprentices to foster literary, social and athletic activities of the apprentices. Each of these clubs bears the name of some popular mechanical officer, the club generally being designated by the latter's initials. Each club has its constitution and by-laws and its duly elected officers. Regular meetings are held wherein papers are read, or talks made, by the apprentices or others and ample opportunity offered for apprentices to acquire a knowledge of parliamentary practice. Sometimes debates are held on

shop subjects. The dances given by some of these clubs have become the social events of the community. Many of these clubs have their own orchestras and other musical organizations. One club gets out a monthly paper or bulletin relative to the activities of the club.

All forms of athletics are encouraged by the management. Baseball, football, and basket ball teams from the various clubs compete with each other for division or system championship. An athletic team can be made an important factor among the apprentices of a railroad shop. The success or failure of the team hinges upon organization and team work. Every player's success depends on his ability to work with those around him in an organized body, each helping the other and pulling together for success. Team work counts whether in baseball football, basket ball, or shop work. In looking at an old photograph of the championship baseball team of 1910, it was observed that nearly every member is now holding a supervisory position.

During the past year, an Association of Santa Fe Apprentice Clubs was formed by the apprentices and a meeting of 120 representatives from the various clubs of the system was held at Albuquerque, New Mexico. The program consisted of inspirational talks by officers of the company and others, a basket ball tournament for system championship, a visit to the new Albuquerque shops and many other features of interest and benefit to the apprentices. Rules were adopted governing interclub contests, these stipulating that no apprentice shall be eligible to play on any apprentice team or to take part in any musical or literary organization unless his school and shop work is up to the required standard.

Special Apprentices

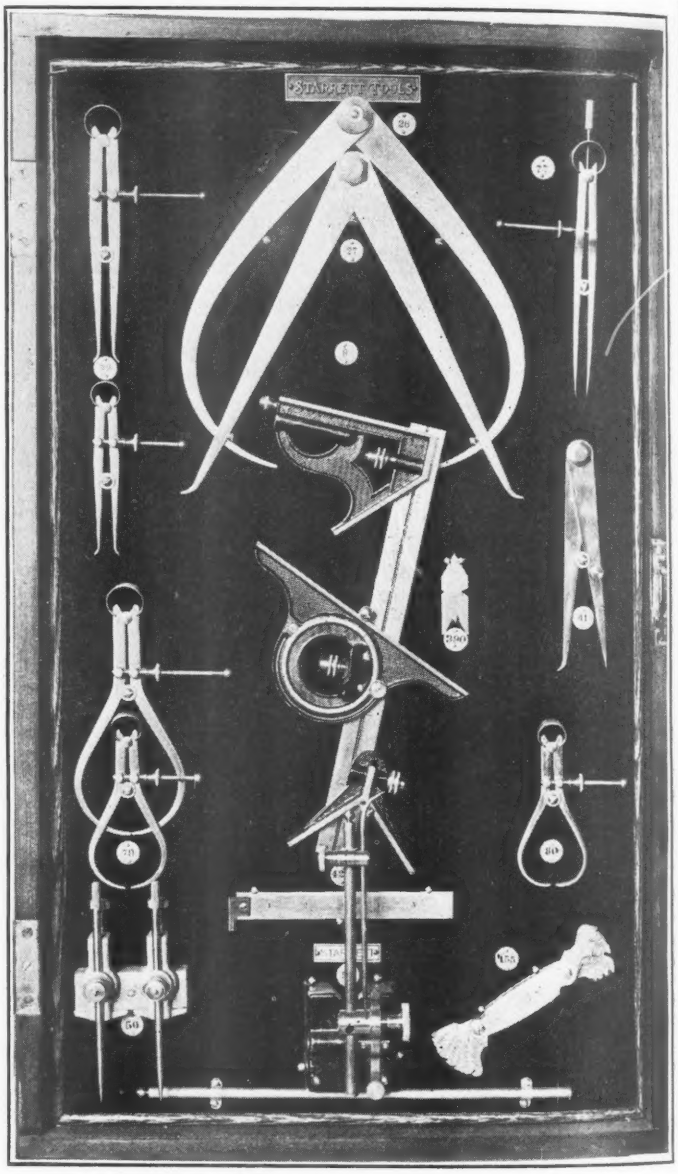
A limited number of special apprentices are employed, one or more being located at each of the division points of the system. These men must have a technical education and are employed only after a personal interview with the supervisor of apprentices or some other officer of the mechanical department. Since they have received sufficient theoretical or technical knowledge while in college, it has been found best to confine their three-year course to actual shop work, a thorough grounding in practical work being necessary to train them for applying the technical knowledge gained in college. Unless supplemented by practical experience, their technical knowledge is of little value in a railroad shop. In order to attract the better class of college men and assist in more careful selection of these special apprentices a limited number of college juniors are employed during the summer months, those showing fitness for special apprenticeships being granted leave of absence in the fall to return to school with the understanding that upon graduation from college they will resume the special apprenticeship course. The three-year special apprenticeship course consists of one year machine work, one year erecting work, and one year of varied work, consisting of four months in the roundhouse, two months in the boiler shop, two months in the freight car shop, two months with the road foreman or traveling engineer, and two months inspection or special work. The purpose of the course is to prepare these men for foremanship or staff duties, but promotions necessarily depend upon the ability and development of the men themselves.

Securing Apprentice Instructors

No difficulty whatever is experienced in securing competent apprentice instructors. They are selected from men employed in the shops, who are familiar with the company's methods and policies and loyal to its interests. The majority of the present instructors are graduates of the apprenticeship courses—young men full of life and ambition, interested in boys and fitted for the job as no men on the outside could possibly be. Since only the best of the graduates are selected for instructorship and the training and experience received as instructors further fits them for promotion, many of them have been advanced to foremanships or other positions of responsibility. In fact the position of apprentice instructor has come to be considered a stepping stone to further advancement.

Developing Foremen

Although the apprentice department was inaugurated to prepare mechanics for the rank and file, and this thought



Complete Set of Tools for a Machinist Apprentice

is ever borne in mind, it has also been found a valuable means of training and developing foremen. In fact, 250 graduates of these apprenticeship courses are now holding official positions in the mechanical department, positions of gang foremen, boiler foremen, car foremen and general foremen. Five of these graduates now hold positions of master mechanic and are making good on the job.

All of these are young men with unlimited possibilities awaiting them. There is no telling to what heights some of them may yet climb. Meantime, others are being trained to take their places as they advance. In fact, it is the policy of the Santa Fe to make all promotions from the company's own ranks and to have a man ready for every vacancy that may arise. The foremen who are themselves graduate apprentices, and especially those who have come up through

positions of apprentice instructor, are naturally interested in the welfare of apprentices, gladly lending their co-operation and assistance in every movement having for its object the training and advancement of the apprentices. Likewise the apprentices and apprentice graduates do everything in their power to assist one of their number in making good when he is promoted. After all, the duties of a foreman are largely those of an instructor.

Results Accomplished

It is impossible to measure fully the results which have been accomplished by the Santa Fe through its apprenticeship system. First, there are the skilled mechanics who have been graduated and are now working in the company's shops. These mechanics have no superiors anywhere. Certainly no others would be so well suited to the road's particular needs. Then there are the promoted graduates, the 250 young men now holding official positions and as many others who are being made ready to take their places as they are advanced to positions of greater responsibility, all young men in the prime of life, with a lifetime of usefulness and service ahead of them.

Personal Characteristics of

....

....

(Please fill out personally, without assistance or knowledge of any other person, indicating with check mark in column. Mail direct to Supervisor of Apprentices, Topeka.)

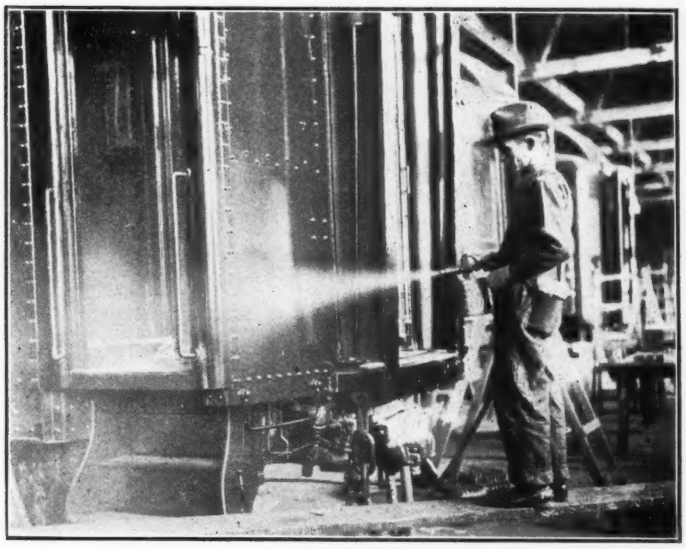
	Very Good	Good	Medium	Poor
Education				
Special knowledge				
Experience				
Honesty				
Morality				
Temperance				
Tact				
Resource				
Reliance				
Foresight				
Appearance				
Memory				
Energy				
Industry				
Initiative				
Persistence				
Assertiveness				
Discipline				
Promptness				
Accuracy				
Personality				
Loyalty				
Executive ability				
Shop work				
School work				
Popularity with authorities				
Popularity with associates				
Is he making good?				

Date.......................... .... Apprentice Instructor.

Form on Which the Personal Characteristics of Each Apprentice Are Rated for Report to the Supervisor of Apprentices

Mention should be made of the work of the shop instructors. In addition to their duties of instruction, they are ever ready to assist the foremen and are able to relieve them during temporary absences. These men are particularly good material for selection to permanent positions as foremen. Without the shop instructors there would be need for greater supervision in most of the shops. The salary of the shop instructor is not considered as an extra expense. Likewise with the school instructors. Were it not for them, someone else would have to be employed to do the shop drafting and other work performed by them. In addition to instruction in the school room, the school instructor looks after all shop drawing and sketching and all blue prints. He is frequently the only technical man around the plant and as such is a very valuable assistant to the master mechanic or superintendent of shops.

Second only to the training and development of skilled mechanics and to the training and recruiting of foremen, perhaps the most visible result of the apprentice training system is the additional output in work performed by apprentices. Little mention is made of this, for it is always considered of less importance than the ultimate output in skilled mechanics for the future. But it must be remembered these apprentice boys are not only taught correct and up-to-date methods but also that time is just as important as materials. Moreover, a young men can excel an older man in a baseball game, or in any form of athletics, or in any contest requiring quickness of mind or of muscle. He is also more desirous of surpassing or outdoing the other fellow than are those of older years. So it is not to be wondered at that when given



Helper Apprentice Receiving Experience in Modern Method of Varnishing Coaches

competent instruction and incentive, he can turn out a large amount of work, often excelling the older mechanic.

The instruction of apprentices also has a wholesome effect upon the other men in the shop. They are more anxious to use up-to-date methods to keep these younger boys from surpassing them. Moreover, the considerate treatment accorded the apprentices has had a wholesome effect on the entire shop body. The good feeling has been contagious and now permeates the other departments, making a better esprit de corps throughout the whole shops.

From every point of view, an apprentice training system, such as is conducted on the Santa Fe, is a paying proposition. No better testimonial to its effectiveness could be made than that given by John Purcell, assistant to the vice-president, in his paper before the Mechanical Division, American Railway Association, last year wherein he said: "The training course for our apprentices has become a fixed part of our mechanical organization. From sixteen years' experience in this course of training, we have satisfied ourselves that it is the only method to pursue to keep our railroad supplied with first class mechanics."

Effecting Economy Through Careful Design

The Relation of Equipment Design to Maintenance as Viewed from the Designer's Standpoint

By H. Y. Carpenter
Chief Engineer, Davenport Locomotive Works, Davenport, Iowa

IF all the rolling stock of a railroad should be scrapped and an entire new lot of equipment purchased to replace it, what an opportunity it would be! The handicap under which all railroads now work would be eliminated. Perhaps it would—for a short time at least. But would the new equipment be so nearly perfect and the parts so completely interchangeable that five years later, after additional equipment had been purchased, these same parts would be even more widely interchangeable than when they first appeared on the road? To a small extent they might be, but in many other instances they would be no more so. Were we content not to progress, the extent of interchangeability might be increased as the amount of equipment owned increased but we must make progress so that what seems perfection today may be little short of obsolete ten years hence.

This article—awarded the second prize in the competition on the relation of equipment design to maintenance—points out the opportunities which are presented to the designing engineer to pave the way for economical maintenance by anticipating future requirements and preparing specifications and designs to meet them. In contrast, the first prize article, which was published in July, gave a mechanical operating man's ideas of the effect of design on maintenance.

The position of the railroads with regard to equipment is peculiar. They must make use of what they have as long as it can be used economically, and still they must keep abreast of the times and not buy new equipment that is an exact duplicate of a preceding order merely because of the economy afforded by the duplication. In many instances that would be false economy. They can, and many do, endeavor to use as many duplicate parts of equipment received on previous orders as possible, but there are many limitations.

For example, a road that purchased a number of eight-wheelers and moguls in 1890 still has many of these locomotives in branch line service, but they have long since proved unprofitable for main line work. The axles, for instance, are smaller than on any succeeding order. The driving boxes are not interchangeable with those of any later locomotives. But one course is open; boxes suited for these locomotives must be carried in stock at many different points because of the fact that these particular locomotives are widely scattered. Equipment has increased in size considerably since they were built, and no one can say that we have yet reached the limit. What is true of driving boxes is just as true of nearly every other part. Each year it has seemed that the limit in size and refinement has been reached, but each year last year's ideas must be revised.

It is out of the question to scrap the present equipment and start anew; the only course open is to make the most of what we have and endeavor to make each future order more nearly ideal. That ideal is elusive; the new equipment must fill the actual needs of the present and the anticipated needs of the future, at the same time using all possible parts that are interchangeable with those on existing equipment. These are more or less opposing conditions, and to make matters worse it often happens that the new equipment is so urgently needed that there is little or no time to give the matter the careful consideration it deserves before placing the order.

Consider the Builders' Viewpoint

One of several ways of purchasing new equipment which will have a decided bearing on the matter of economical design may be followed. The builder has no time to investigate conditions on the road purchasing the equipment; he has his hands full meeting the specifications and the delivery date. If he can use a driving box that has been used on locomotives for some other road for which he has the necessary patterns, but which may not interchange with any box on the purchasing road, it is to his advantage to do so. The fact that the purchasing road will have another driving box to add to its already long list of boxes that must be carried in stock at many different points on its line is not a matter of much concern to the builder. He was not bound by contract or specifications to use any particular driving box and the one used was subject to no criticism because of faulty design. The specifications have been met and a satisfactory piece of equipment delivered; satisfactory perhaps in every way but one. Practically all of its parts differ from those of any equipment on the purchasing road, with but one inevitable result increased stocks must be carried and repairs are certain to be delayed.

Another serious mistake is never to be prepared for an order for new equipment. Usually when the order for equipment is placed the operating department is more than ready to put it into service. There is no time available to go over the design in detail. Furthermore, the new equipment may be specified to differ materially from any the road then has in service. Specifications must be rushed out and an order placed immediately, for early delivery is of paramount importance. As in the preceding case, the builder does his best, and delivers equipment wherein many parts could have been used that were interchangeable with other equipment on the road, but were not. Hence, while giving the operating department the desired relief, repairs when necessary were found to be needlessly delayed and expensive. These are conditions as they have developed many times and to overcome them is the problem.

Anticipate Future Requirements

"Haste makes waste" is a time-worn adage, but it is only too true in the purchase of new equipment. Hastily conceived designs hastily built and delivered may give the operating department quick relief; the locomotives may move

trains over the road economically as far as fuel and water are concerned, but when they come in for repairs, as they must sooner or later, the cost of repairs and the delay in making them is pretty sure to be greater than necessary. Remove the "haste" and anticipate the needs of the future. Let those responsible for the use and repair of equipment inform the mechanical department of any ideas as to changes or improvements—not after the equipment is ordered and it is too late, but at the time the idea comes to mind. Let the mechanical department always be prepared, so that when the word is passed that certain new equipment is to be ordered it will not come as a thunderbolt out of a clear sky.

Preparedness is necessary, tentative designs and specifications incorporating future needs and eliminating errors of the past should be constantly in the course of preparation, never losing sight of the importance of using all parts possible common to existing equipment or, of making parts of one new design common to other new designs. These should be ready for a final consideration when the order is to be placed and not cause any delay. These designs should be complete in every detail and leave nothing for the builder to do but make the parts accordingly. The design has been made where the equipment is to be used, where the needs of the purchasing road are best known, and not under the stress of meeting a certain delivery date so near that it seems next to impossible to meet it.

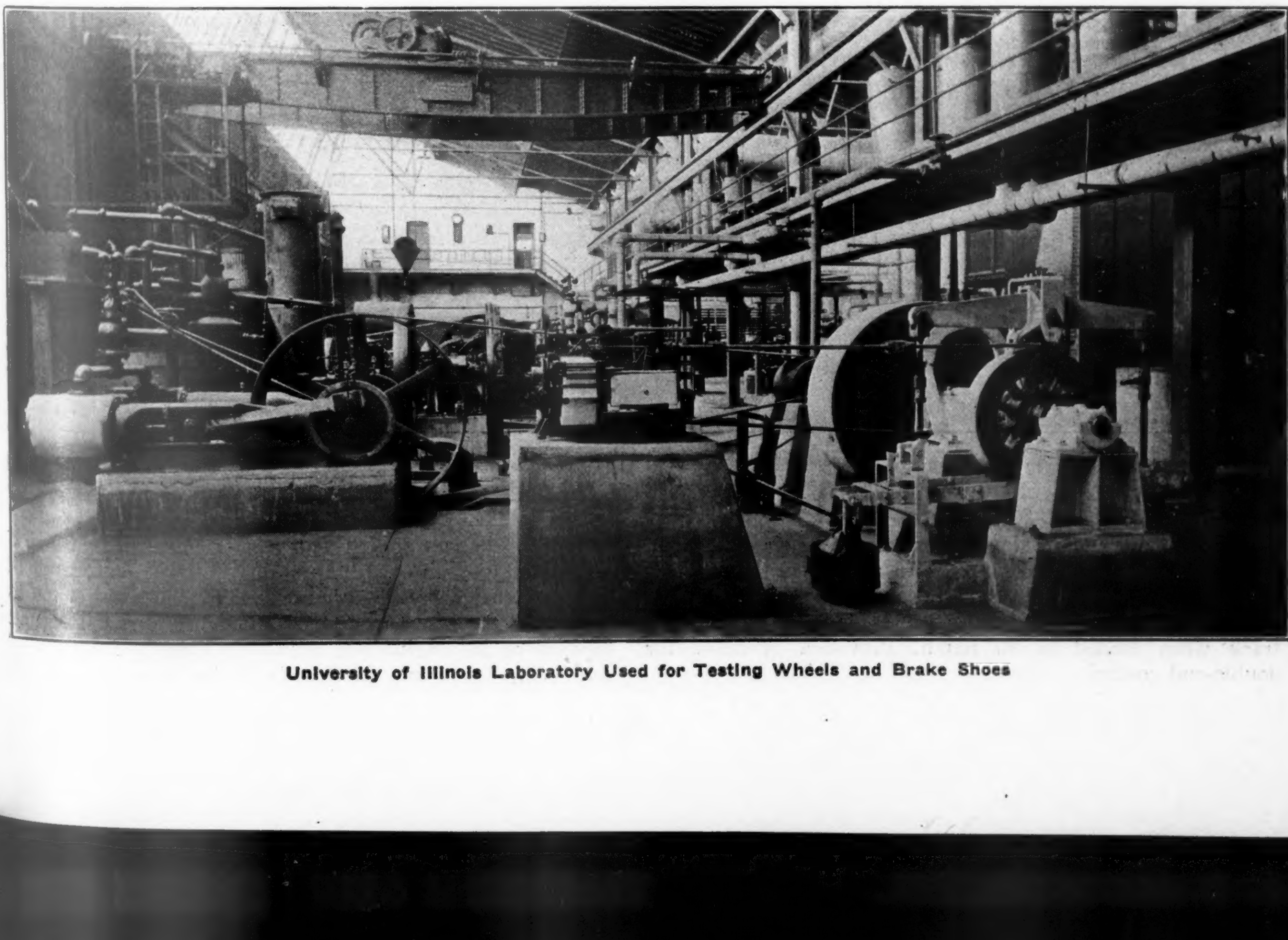
Engineering Department Must Be Progressive

To do this means but one thing: the mechanical engineer's department must be put on the map. It must not be held down to a small number of incompetent men. It must be raised from the almost irresponsible position it occupies on some roads—a place where the shop can get sketches converted into drawings, considered a necessary evil by the management—to one which not only keeps the shops supplied with all the information they require, but also gives the bidder on new equipment a complete specification together with detail drawings of each and every part that is to enter into the design, from which the builder should not be privileged to deviate. The new equipment, when delivered, should be well adapted to the requirements of the purchaser. Provided, however, the interchangeability of parts has not been accomplished then adaptability cannot be complete.

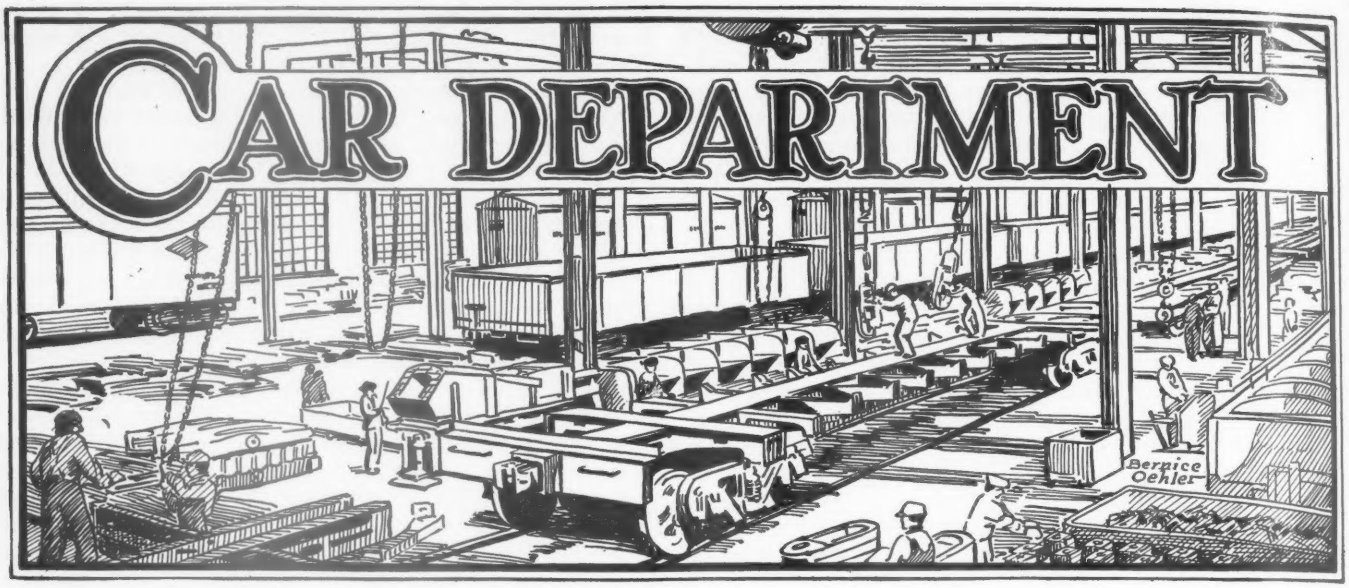
In this no short-sighted policy can be pursued. The mechanical engineer should see that he is informed of the failure of every part of a car or locomotive that was not brought about through accident. A complete file of failure records should always be available. The shortcomings of existing equipment should be brought directly to his attention with a view of correcting them on existing, as well as on new equipment. The management must be willing to give the mechanical engineer such a force as is necessary to meet the requirements and raise his department from a mere drafting room to an engineering department—in fact, as well as in name. It is then up to the mechanical engineer to see that his department is not a place where men who would not last over night with a manufacturing concern can drift aimlessly along, but that it becomes an active part of the organization whose duty it is to design new equipment and to redesign old equipment in such a way that the minimum number of repair parts can be carried in stock and the cost and ease of making repairs are considerations of vital importance at all times. He should see to it that the department is alert and that a broad program for the future is constantly being studied and improved upon.

Conclusion

In this way, with the equipment designed in detail—not in general—where it is to be used, maximum interchangeability will be accomplished permitting parts to be manufactured in large quantities with a resultant saving due to quantity production. As no road can disregard its existing equipment, such a course, if adopted, would not be of immediate and conspicuous benefit. But there should be an ever-increasing improvement, which would become more apparent as time goes on. While impossible to trace the direct saving through the larger and more efficient force under the mechanical engineer, it is certain that the saving effected would nearly, if not completely, offset the additional expense charged to an increased office force.



University of Illinois Laboratory Used for Testing Wheels and Brake Shoes



Self-Propelled Passenger Car on N. Y., N. H. & H.

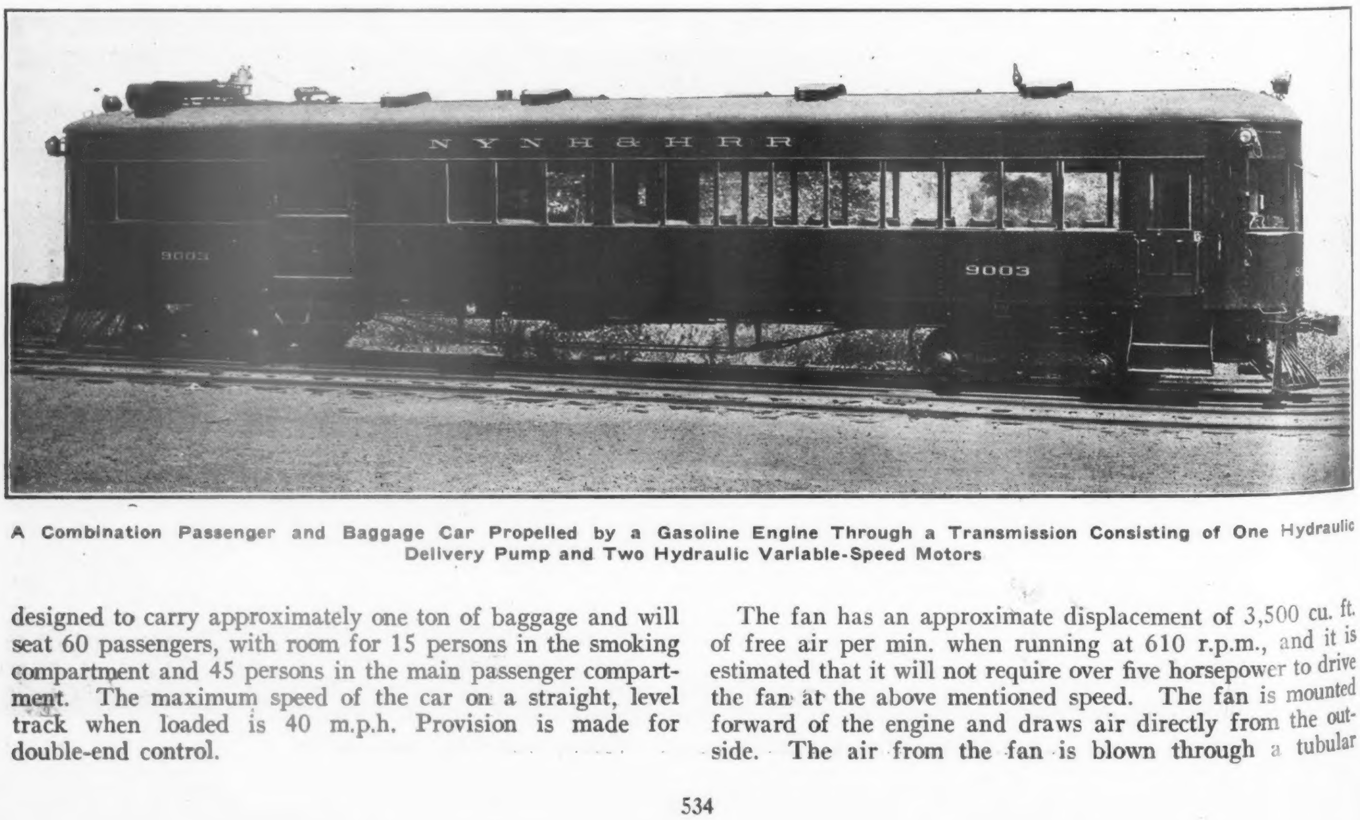
A 150-hp. Ricardo Engine Operates a Pump Which Supplies Oil to Two Hydraulic Motors

The New York, New Haven & Hartford has had in operation for some time a combination passenger and baggage unit car which is propelled by a 150-hp. Ricardo engine, through a transmission consisting of one Size 50, Universal hydraulic variable-delivery pump, supplying oil to two Size 20, Universal hydraulic variable-speed motors, one mounted on each truck frame. The actual light weight of the entire car, including engine and transmission, is 52,800 lb.

The car body has an overall length of 57 ft. 8 in. and is designed to carry approximately one ton of baggage and will seat 60 passengers, with room for 15 persons in the smoking compartment and 45 persons in the main passenger compartment. The maximum speed of the car on a straight, level track when loaded is 40 m.p.h. Provision is made for double-end control.

The Driving Mechanism

The Ricardo engine is rated at 150 hp. when running at 1,200 r.p.m. However, in this installation the speed is being limited to 950 r.p.m., with a consequent limitation in power. In addition to driving the pump unit, the engine drives a jack shaft by means of a Whitney silent chain. This jack shaft in turn supplies power to the fan, air compressor and pump for supplying oil to the speed gear control. Gasoline for the engine is carried in two 25-gal. tanks suspended under the floor of the baggage compartment.



A Combination Passenger and Baggage Car Propelled by a Gasoline Engine Through a Transmission Consisting of One Hydraulic Delivery Pump and Two Hydraulic Variable-Speed Motors

The fan has an approximate displacement of 3,500 cu. ft. of free air per min. when running at 610 r.p.m., and it is estimated that it will not require over five horsepower to drive the fan at the above mentioned speed. The fan is mounted forward of the engine and draws air directly from the outside. The air from the fan is blown through a tubular

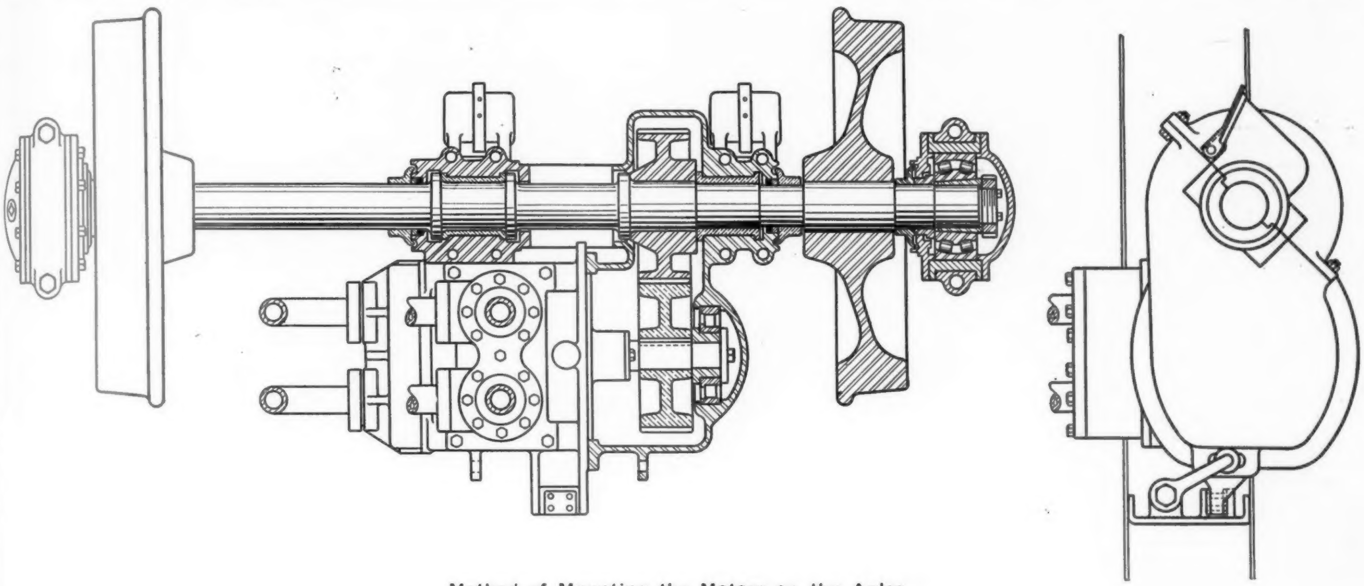
radiator and exhausts through the roof. The cooling water for the engine is circulated through the radiator by means of a circulating water pump, which is mounted as a part of the engine unit.

Air Compressor and Pumping System

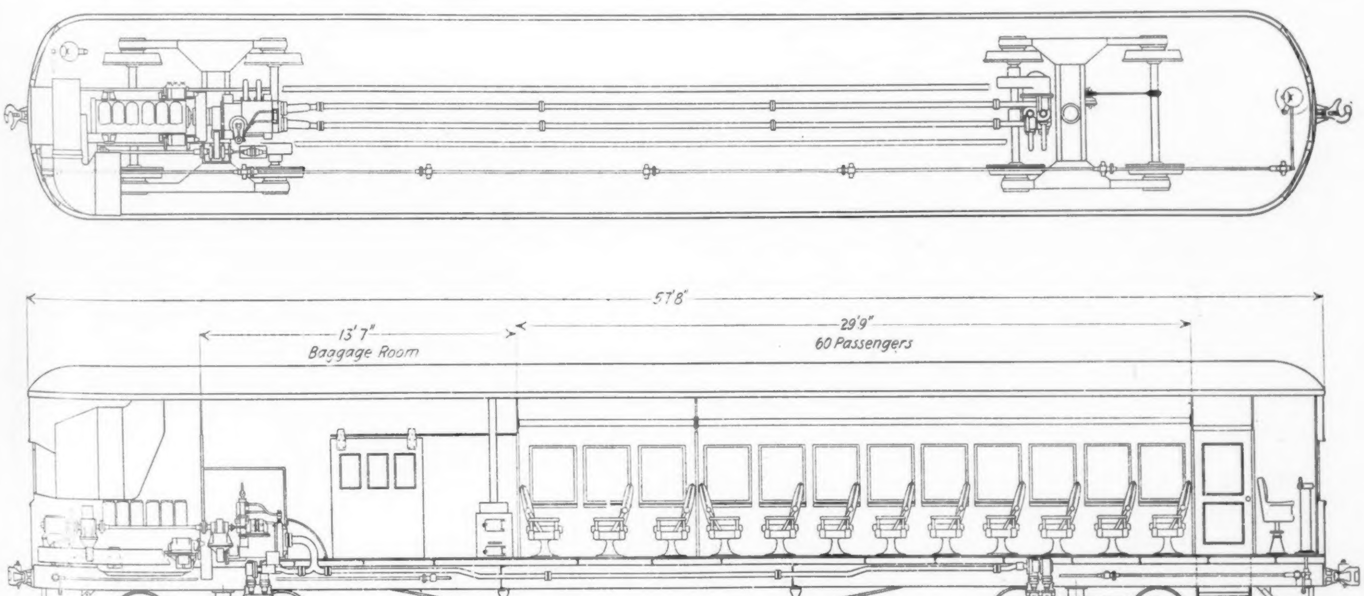
The air compressor is the Westinghouse F-1-B, which has a nominal rating of 15 cu. ft. of free air per min. when operating at 220 r.p.m. against 100 lb. air pressure. However, as only 50 lb. of air pressure is to be carried for this installation, the speed is being put up to 330 r.p.m. and delivery will be about 25 cu. ft. per min. At this pressure it is estimated that the power required will not exceed two horsepower. The air compressor is driven from the jack shaft through a Thermoid flexible coupling.

A Diehl Manufacturing Company's generator is driven from the front end of the engine through a flexible coupling. This generator is shunt wound and delivers 23 amperes at 33 volts when operating at 950 r.p.m. It supplies current for starting, lighting and ignition, and also charges a 32-volt battery.

A Waterbury Gear Company's Size 50, Universal hydraulic, variable-delivery pump is driven from the engine through a double helical gear reduction, ratio 53 to 23, so that when the engine is running at a speed of 950 r.p.m., the pump, or so-called A-end of the transmission, runs at 410 r.p.m. The Waterbury variable speed gear consists of an oil pump designated as the A-end and a hydraulic motor designated as the B-end. Oil from the pump, or A-end, is carried through pipes running just below the floor to the two motors, or B-end. In order to provide for movement of the trucks when the car is going around curves, or when encountering obstacles on the rails, two ball joints and one sliding joint are placed in each pipe line. Each of the ball joints has sufficient swing to allow for a movement of approximately 15 deg. each way. This movement is somewhat in excess of what will be encountered when the car is on a curve having a 100-ft. radius. The sliding joints are placed in vertical planes and



Method of Mounting the Motors on the Axles



Plan and Elevation of Gasoline-Hydraulic Passenger Car

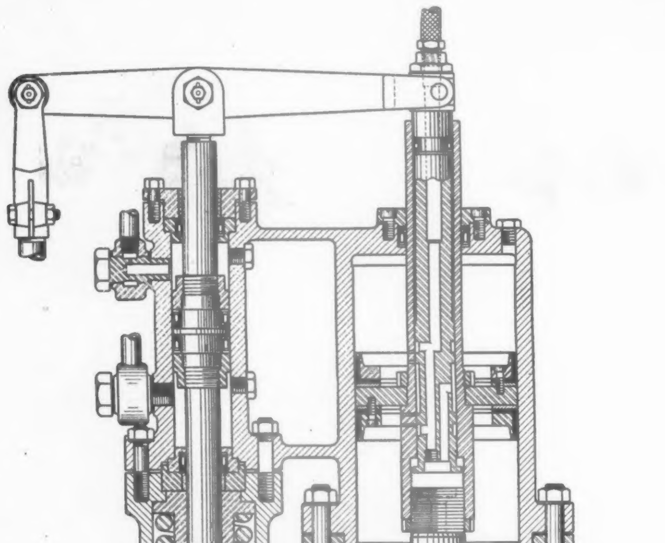
take care of the vertical movement of the trucks when passing over obstructions on the rails, or the movement of the car body when the springs are flexed.

The Motor Units Are Suspended on the Axles

The motor units are suspended on the axles by a method similar to that employed in suspending electric motors on electric locomotives. The lugs for the bearings are cast integral with the case of the motor unit. On the opposite side from the axle a suspension lug is provided which is also cast integral with the case and carries a hardened steel top and bottom plate. These plates are held between other hardened steel plates attached to the truck transom. This arrangement provides for misalinement of the axle relative to the transom and also allows for a slight movement of the axles up and down due to the flexing of the springs.

On each side of this suspension lug are two lugs engaging links, which in turn are attached to the truck transom. These auxiliary lugs only come into action in case of failure of the main suspension lug and prevent the motor from dropping to the track if the main suspension lug should fail.

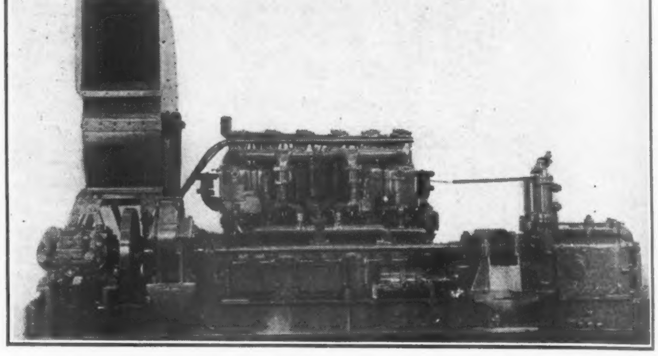
Gearing is used between the motor shaft and the car axle. The maximum speed of the motor unit is 515 r.p.m. At this speed the car axle will run at 450 r.p.m. As the car wheels are 30 in. in diameter, this is equivalent to a speed of 40 m.p.h. The housing for these gears is cast integral with the motor end case.



The Control Mechanism for the Universal Hydraulic Pump

The engine, pump unit, fan, generator, air compressor and servo-motor oil pump are all mounted on a structural steel sub-base. This sub-base is insulated by means of rubber pads from the main frames of the car. This prevents the telephoning of vibration and noise back into the passenger compartments. The rubber insulating pads are protected from oil and grease to prevent deterioration of the rubber.

Ventilation of the engine compartment is effected at the will of the driver by opening a gate into the fan casing so that part of the air taken by the fan will be drawn through the engine compartment. The car is heated by a Peter Smith Company's No. 2 P. O. heater, complete with motor wound for 32 volts and blower for forced ventilation, located in the baggage compartment of the car. The car is supplied with standard air brake equipment and also with hand-operated brakes. The main axle journals of the car are mounted in S. K. F. standard roller bearings.



This 150 hp. Ricardo Engine Drives the Pump Unit Air Fan and Air Compressor

Flexibility of Control

With the Universal hydraulic variable-speed transmission all variations in the speed of the car, as well as reversal of direction of movement, is effected in the hydraulic variable delivery pump. At all speeds of the car from full speed in one direction to full speed in the opposite, the engine runs at constant speed and in one direction only. The control of the Universal hydraulic delivery pump is effected by means of a servo-motor. This consists of a pressure operated piston acting directly on the control shaft of the pump. Oil is admitted to either side of this piston at the will of the operator by a small control valve. Movement of the control valve is effected by means of links and an oscillating shaft which runs the entire length of the car. The movement, through approximately 90 deg. of a small hand lever in either driving compartment oscillates this shaft through approximately 30 deg. This is sufficient to move the control valve from neutral to full stroke in the opposite direction, with corresponding reversal in direction of movement of the car. The control valve is incorporated in the servo-motor piston, and a slight movement of the valve uncovers a port in this piston, allowing pressure oil to flow into the main servo-motor compartment, moving the piston in the same direction the valve has been moved. When the piston moves an amount equal to the movement of the valve, the port is closed, shutting off the flow of oil and bringing the control shaft of the speed gear to rest. In this position the control shaft is oil locked until the control valve is again moved. This method of control is as positive as a screw and nut, but relieves the operator of practically all effort.

The oscillating control shaft above mentioned is mounted in ball bearing pillow blocks on the frames of the car, and universal joints are introduced at necessary intervals in order to prevent binding of the shaft in the bearings due to twisting of the car frame. By these means the effort required to move this control shaft is reduced to a minimum.

A pressure control is incorporated in the control system.

This pressure control begins to operate at about 450 lb. oil pressure. As the oil pressure exceeds 450 lb., the stroke on the pump is automatically cut down so that by the time the oil pressure has reached 1,000 lb., the stroke has been reduced to one-fourth of the full stroke. The design of this pressure control is such that at speeds of from about 25 miles up, the horsepower output of the engine is maintained practically constant, and the speed of the car is determined by the oil pressure in such a way that it is impossible to stall or overload the engine on grades. It is also unnecessary for the operator to take any action when approaching a grade, as the pressure control will operate automatically to do what he might do, but in a much more uniform manner.

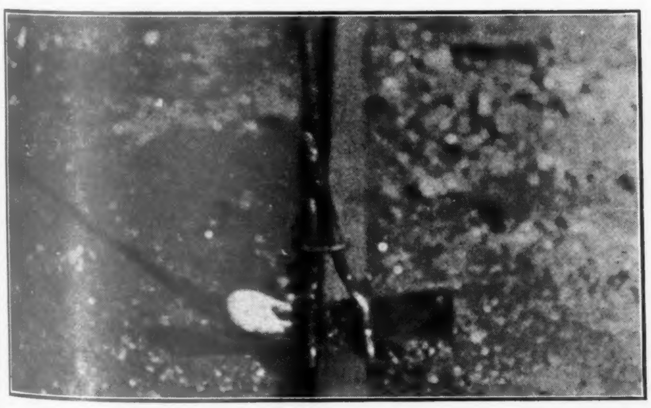
The car wheels have a diameter of 30 in. and the main diameter of the car axle is 3¾ in. This is increased to 3⅞ in. in the motor journals and a shoulder 5½ in. in diameter is provided on each side of the center motor journal in order to take care of the end thrust due to the tendency of the motor to shift on the axle when the car is going around curves. The driving gear on the car axle is a steel forging having a nominal bore of 4 1/16 in. No keys are provided for this gear, but the gear is pressed on to the axle by a pressure of 35 to 45 tons.

Suitable guards and dust rings are provided to prevent dust getting into the gears and main motor journal bearings. Lubrication of the motor journal bearings is provided for by incorporating waste filled oil wells in the journal castings. These oil wells are similar in construction to those used on motor mountings on electric locomotives.

Clamping Device for Attaching Blue Flag to the Rail

By Charles Nugent
General Car Inspector, Florida East Coast Railway, St. Augustine, Fla.

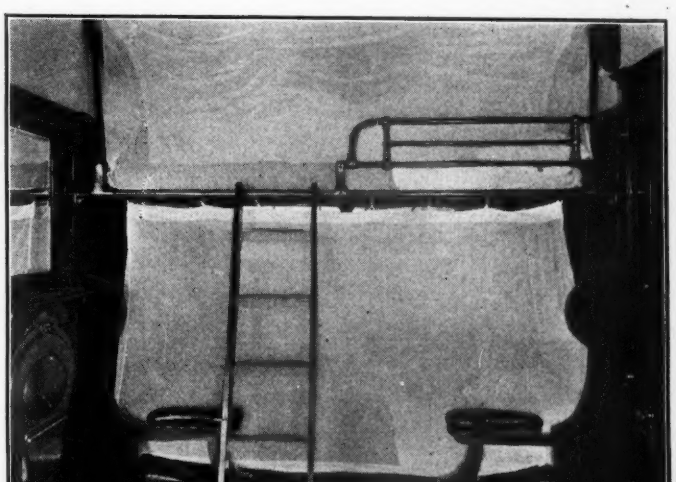
Quite often a blue flag attached to a mast which is pointed at the end will fall down when stuck into the ground or track ballast. This is a dangerous condition as a locomotive is liable to be coupled to the cars and moved while the carmen are working under them, due to the fact that the train crew did not have any means of knowing that the cars were being worked on without a man walking the entire length of the train. In order to eliminate any possibility of a flag becoming misplaced or falling down after it has been once placed in position, the clamping arrangement shown in the illustrations has been devised so that the mast of the blue flag can be locked in position on the rail.



The Clamp Can Be Locked to Any Size Rail

The position in which the signal is held and also the manner in which it is clamped to the rail are shown in the illustrations. The outside jaw is a loose fitting piece and is fastened to the rail by a slip ring and wedge shaped key. The jaws extend under the head of the rail and the wedge shaped key is so constructed as to take up the space on any size rail. After the flag is applied to the rail the slip link is dropped down which fits into notches on the mast, and the outside jaw and the wedge shaped key is thus tightened to the rail so as to hold the mast in a perpendicular position. The key is provided with a slot through which a padlock can be inserted thus preventing the key from being removed by any unauthorized person. This also insures the flag being left in the proper position as it cannot be removed until the lock has been opened and the clamp removed. The mast is made of round wrought iron bar stock of sufficient strength to hold the flag and lantern over the center of the track without sagging.

Showing Lantern Suspended on Mast Over Center of Track



The Berths Used in Sleeping Cars on the Siamese State Railways are Similar to Those Used in the United States

Intelligent Oilers Will Prevent Hot Boxes*

Men Must Be Taught the Importance of Their Job—Eternal Vigilance Is the Price of No Hot Boxes

By Oscar Skegsberg
Assistant Car Foreman

HALF the energy of the average car foreman is utilized in trying to subdue the refractory hot box; the nemesis that haunts his dreams in and out of season. How to stop this perennial epidemic is the problem which every progressive carman has set his heart on solving.

That this will be accomplished in time no one who knows the caliber of the leaders of car work will deny. A great many of the facts of science were built up by the contributions of small items of fact from thousands of unknown investigators. For this reason the writer ventures to set forth the ideas developed by his company for the reduction of the hot box evil, in the hope that it may help some one to form a better plan. He can say, however, without boasting that the number of hot boxes has been reduced about 50 per cent.

This paper was awarded second prize in the hot box prevention competition which closed March 1, 1924. The inspection and maintenance of journal boxes is generally considered by railway officers, as a job that can be assigned to any unskilled laborer. No thought is given to teach the oiler the relation of the contained parts of the box to proper maintenance. He is led to believe that he is performing a menial job and is never encouraged to think further than his dope bucket and packing hook. Consequently, when an epidemic of hot boxes occurs it is traced back to men who do not thoroughly appreciate the importance of proper inspection and maintenance. The writer, realizing the importance of the human phase of this problem, has set forth in a clear and concise manner, how he believes it can be solved.

In the past, as far as my experience goes, it has been the practice of railroads, when in need of car oilers, to hire the first unskilled men who applied for a position with the result that they had men on their payrolls with no qualifications for railroad work, nor any interest in the job except pay day. This resulted in producing indifferent work—a faithful ally of the hot box. It has been stated that it requires neither skill nor knowledge to pack a journal box. I hope to prove that it requires a bit of skill, conscientious work, and a great deal of information to be a successful oiler. I might add that unskilled poking is the cause of half the hot boxes.

The writer has found that the average man is indifferent to his work, not from want of interest, but from lack of the right information. Frequently a new man is hired, taken by the foreman to the yard and curtly informed; "Here's the dope bucket, there's the cars. Go to it." Naturally the man is going to get by as easy as he can. On the other hand, if the foreman takes a little trouble to explain the details of the work, show him how it is done and why it is done, then, as he gradually grows more accustomed to the work, show him the possibilities of the job in new angles of interest, such as conditions about the wheel and journal and what these things indicate, his interest is heightened, his intelligence is challenged, and you have supplied the incentive to do good work.

Of course, this method takes time, but I believe it is justified by the results obtained. The foreman should never allow the interest to lag but should point out the best methods of treating different journal boxes and explain why. He should explain the different mechanical defects about a car that may cause a hot box and why it may cause heating. In this way the oiler develops into the faithful, intelligent workman, so essential for success. He is never at a loss to know what to do and how to do it. Instead of the aimless, monotonous poking of innumerable boxes, he will discover individual characteristics in each box, demanding a variety of treatment and, being interested, will take pride in doing his work well. Only in this way can the hot box problem be solved.

Preparing the Packing

Ordinarily, preparing the packing is a prosaic job, rather disagreeable, and to be finished as soon as possible. To all appearances it is an oily subject, devoid of interest, but the foreman can usually enliven the work by asking a few pertinent questions and start a discussion about the wick action of the waste; how throwing the waste promiscuously in the vat destroys this action; why it is necessary to thoroughly saturate the waste with oil; that one pound of waste will absorb four pints of oil; that oil of a good quality should have body and elasticity, feel smooth to the touch, and stretch out when the thumb and the forefinger are slowly separated and that this elasticity of the oil allows it to adhere to the journal in a thin film or protecting coat against friction between the journal and the brass. Knowledge of wick action will lead the oiler to stir up hard packed boxes to break the glaze.

Proper Packing of a Box

Another operation of equal importance to preparing the waste is the proper packing of the boxes. All the boxes should be thoroughly cleaned and free from grit. This done, the back roll, crescent shaped to fit the contour of the box, is worked carefully back to the extreme rear end of the journal box leaving it in such a position that it does not extend above the center line of the journal. Then spread the packing over the entire mouth of the box, allowing it to overhang outside, and push it evenly back with the packing knife always adding more packing before the final strands are put in the box. In this way all the packing is bound together in one mass. The packing should not extend above the center line of the journal as it increases the chances for waste grabbing.

*Awarded second prize in the competition on hot box prevention which closed March 1, 1924. The paper awarded first prize was published in the August issue of the *Railway Mechanical Engineer*.

Having learned how to prepare the packing and to pack a box properly, the oiler should then be taught not to apply his packing knife indiscriminately to all boxes but to distinguish the condition of each box, the appearance of the wheel, journal box, wedge, brass and the packing. Each tells a story to the practiced eye.

Many able leaders have protested against the needless stirring up of the packing as a useless labor, doing more harm than good. This is good advice as far as it goes, but with one reservation, that the oiler should know the conditions of the journal box that makes the operation a waste of labor. It also has the merit of saving time and avoiding delays to trains. A journal box of this kind can be readily seen at a glance, if the packing is properly adjusted and of the right saturation; if the brass and the wedge is in good order; and if by feeling the journal with the ball of the index finger, a thin film of oil adheres to the finger from the contact it is safe to say that it will reach its destination without causing any trouble.

It must be insisted, however, that the time saved on good boxes should be devoted to those that require attention of which, unfortunately, there are too many. During a cold spell the packing is almost uniformly forced in a hard ball to the front of the journal box. This is fatal to a cool journal. To force it back is useless. If the packing is not frozen too hard it should be disengaged and spread out, then woven uniformly to the back of the journal box and additional waste supplied until there is enough to reach the center line of the journal. If the ball is frozen too hard to work in this way, it should be taken out and the box repacked with fresh packing.

The oiler should always be instructed to take great care in removing pin grease from any box and then to repack it carefully. I may be prejudiced in this matter but when it is realized that the journal attains a considerable temperature before the pin grease comes into action, and that it tends to destroy the wick action of the waste strands by forming a glaze underneath the journal, it is good policy to remove it.

Overpacked Boxes

The number of boxes that are overpacked is surprising. In some cases the brass can scarcely be seen. The sides and end of the journal box are jammed full with perfectly good packing but entirely useless for the purpose intended. This condition must not be allowed to remain if one wishes to avoid hot boxes, for not only is it a continual menace as a waste grabber but, owing to the jammed in packing, is a cause of a glazing underneath the journal. The only remedy is to remove the superfluous packing and readjust the remainder. In this connection it may be well to state that all boxes should be examined to see that no packing is in position to cause a waste grab. Eternal vigilance is the price of no hot boxes.

A feature that will catch the oiler's eye is the scattering of oil over the wheel. Usually this is regarded as an indication of a hot box. Even though the journal is not heating it shows an unhealthy condition. It may be that the packing is dirty and chewed up until it is of the consistency of a black pasty muck. The oil, instead of adhering to the journal, is cast off on the revolving wheel. Obviously, lubrication is impossible and the box must be repacked. If a new brass is noted, this condition may be caused by the spreading of the lining, uneven lined or hard spots in the babbit, lining rough and pitted or there may be nicks, pits or ridges in the journal. These defects easily multiply the number of hot boxes.

Glazed Packing

There is also another source of a great many hot boxes that must not be overlooked; that is, the formation of a hard glaze underneath the journal preventing wick action of the waste and choking off the supply of oil to the journal. On this kind of boxes the intelligent oiler is invaluable. He notices that the packing seems to be good but the oil adhering to the journal is pitchy, black and sticky to the touch or there may be scarcely any oil clinging to journal. In a well lubricated box, the oil appears fresh and of a dark amber color entirely different from the above. At any rate, the adjustment or stirring over of the packing is absolutely necessary. Taking the packing hook the oiler pulls the packing towards him from the sides of the journal, spreading it evenly over the mouth of the box. Then he weaves it back again in the regular manner as if packing a new box. In this way the glaze is broken and the saturated dope is in contact with the journal and the wick action is restored.

Dry Boxes

Another ounce of prevention that is worth while, is the proper handling of boxes that have run dry. Quite a number of these boxes are encountered during a day's work and it will be admitted that these boxes must be replenished somehow with more oil. I am not an advocate of the oil can method as I think it is a loss of good oil and of labor. In the first place, how can a dry box be detected? From my own experience and by experiment, I have found that a good sign of a dry journal is the dry, smooth, shiny appearance of the end surface of the journal, especially around the center punch. This should be handled as follows: The oiler carries in his bucket a small quantity of rich packing to be used for this purpose. He pulls out the packing from both sides of the journal, spreading it out and over hanging the mouth of the box until he has a sufficient vacant space on each side of the journal, then, inserting the rich packing in place of that removed, he weaves it evenly back in one mass as if packing a new box. In this way the rich dope will be in a place where it will do the most good, that is, in direct contact with the journal. The oil is not as liable to run off and spatter the wheel as when it is applied with an oil can.

The mechanical defects of cars that contribute to the causes of hot boxes have been omitted for the reason that these defects have been so thoroughly covered and so ably presented, that anything I could say would be only a feeble echo. Nevertheless, this knowledge is so important that no inspector or oiler can afford to ignore them. Variety is the spice of life or of a job. For this reason I have always brought to the attention of the men any authoritative statement, new or old, that would present their routine work at a new angle and thus arouse their interest by urging them to test it out.

In summing up the requisites for a good box oiler it is essential that he be given an incentive in connection with his work; that he be drilled in the fundamentals of every day routine; that his mind be given something to work on, and that he be made to realize that the study of lubrication is worthy of the keenest minds. If the foreman succeeds in driving these points home to his men he will change his men from dull mechanical plodders to intelligent, conscientious workmen who will take pleasure and pride in their work. After all, it is the personal equation, not the hot boxes, that is the real problem to be met.

The Kansas City Southern reports for the first quarter of 1924 only 1 death and 69 reportable accidents among employees as compared with 3 deaths and 110 reportable accidents for the corresponding period of 1923.

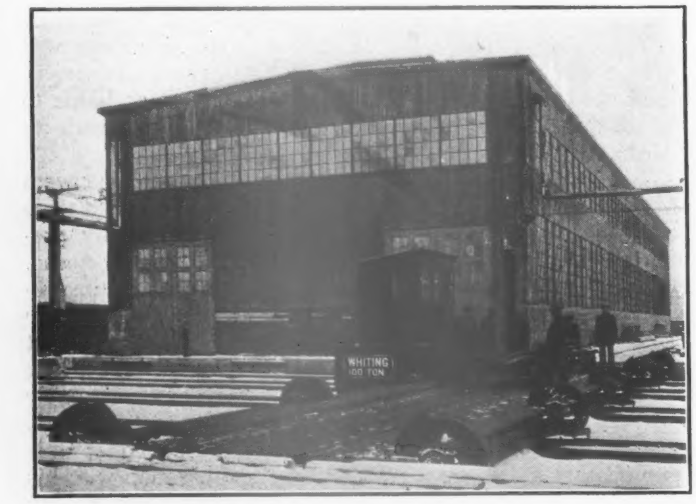
Plans for the Joint Use of the Southern Pacific passenger station at Fifth street and Central avenue, Los Angeles, Cal., by the Union Pacific and the Southern Pacific, have been approved by the Railroad Commission of California. In return for permitting the Union Pacific trains to use its station, Southern Pacific freight trains will be routed hereafter on the Union Pacific tracks on the east bank of river at Los Angeles.

New Car Repair Facilities for the D. & R. G. W.

Modern Wood and Steel Car Shops Are Organized with Station to Station Method and Balanced Gangs

Double String of Gondolas Just Out of New Wood Shop Ready for Painting

INCREASED labor rates and the resultant increased cost of freight car maintenance have made the provision of adequate car repair facilities vitally important. The extensive program of the Denver & Rio Grande Western for reconstructing and modernizing its freight car repair facilities throughout the system was referred to in an article in



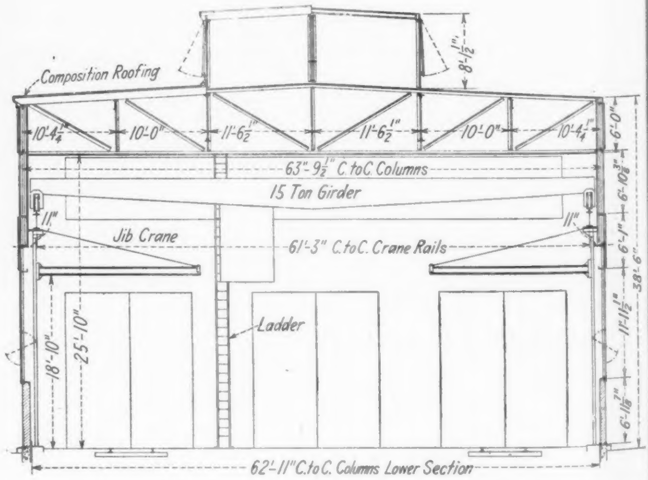
Steel Car Shop Looking North—80-Ft. Whiting Transfer Table in Foreground

last month's issue and further details will be given in this article. The program calls for identical freight car repair shops for both wood and steel cars at Denver and Salt Lake City. At Salida and Grand Junction old locomotive shops, vacated through the provision of new buildings for locomotive repairs, have been made available for housing the heavy repair freight cars originating at these intermediate terminals and not scheduled for repairs at the main plants.

Steel Car Shop

The new steel car shop at Denver is a steel building about 65 ft. by 242 ft. in area with brick walls up to the sill height and Robertson process asbestos protective metal covering above. It is served by two tracks which run from the transfer table through the building and out into the car yard at the other end; also by a third stub track between these two which enters the building from the car yard and extends two car lengths inside. Two overhead traveling cranes span the building and serve to lift the car bodies, trucks, steel frames, sheet metal and other heavy material. The through tracks lie well toward the sides of the building, leaving a center aisle directly accessible to both tracks for working space. Jib cranes are provided on every column along the tracks for lifting parts and handling riveters.

The stub track serves as a material track for bringing in materials from outside to be unloaded by the cranes. It is also provided with floor beams and a special design of car straightener for pulling bent steel cars back into shape. The foundation for this car straightener is best shown in the photograph which was taken at night and which also shows the effectiveness of the lighting system employed. The large



Transverse Section Through Steel Car Shop Showing Roof Construction, 15-Ton Traveling Crane and Jib Cranes

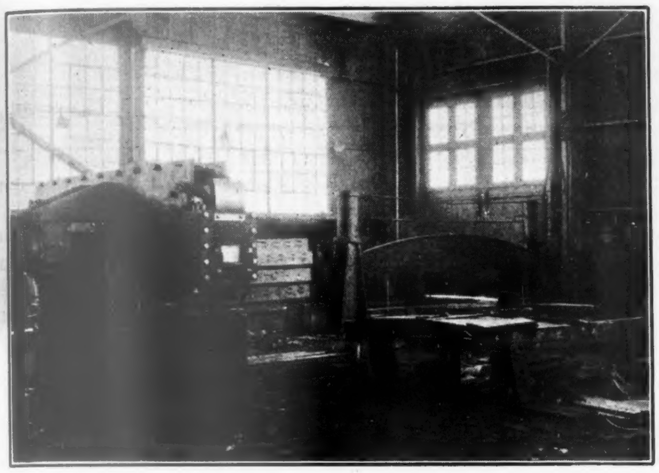
areas of glass in the saw tooth roof construction and side windows give effective illumination on cloudy as well as clear days.

The shop is open to the old car wheel shop by way of the transfer table for wheel and axle repairs and replacement. The equipment of the new shop consists of the jib cranes, two 15-ton Whiting traveling cranes, one 16-ft. air clamp, two Buffalo combination punching and shearing machines, one drill press, one double dry grinder and one straightening

stall. The 32-ft. transfer table which served the car shops under the old layout has been replaced by a Whiting 100-ton, 80-ft. transfer table.

Wood Car Shop

The wood car shop, lying directly across the transfer table, is served by three tracks running from the table lengthwise through the building and out into the yard at the south end. This shop is of timber frame covered with Robertson



Flanging Clamp and One of the Buffalo Combination Punching and Shearing Machines

process metal, the building being 65 ft. wide by 240 ft. long. The center track is intended for truck repair work when all-wood cars are going through the shop, the car bodies paralleling the trucks, mounted on dollies on the outside tracks.

Night Work Is Facilitated by Ample Artificial Illumination—Foundation and I-Bolts for the Jacking Stall Shown in Left Foreground

A Box, 7½-ton, electric traveling crane, operated from the floor, spans the center track and assists in handling the trucks.

Balconies at car roof level extend through the shop in the center track bay and in two narrow bays outside of the two outside tracks. These balconies are connected together by three equally spaced lift bridges over each side track, giving a continuous working floor at car roof level. In addition, scaffolds carried on brackets attached to the building posts and adjustable to any desired height, are located along both

Wood Car Shop—Outside Material Elevators Shown at Right and Left

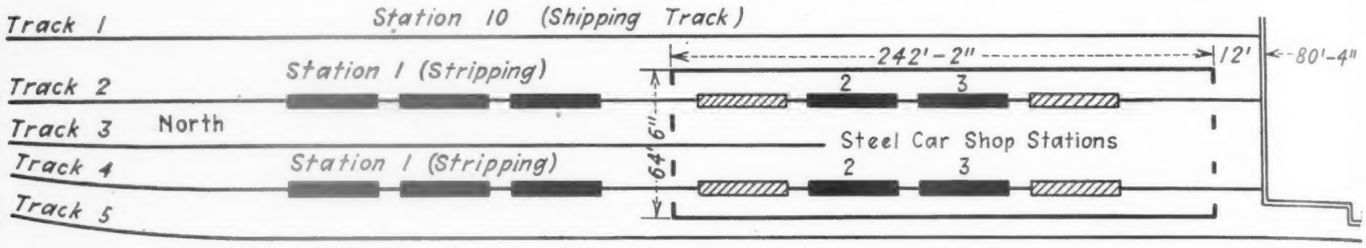
sides of each of the car tracks. Four specially designed electric hoists are provided over the side tracks at each end of the shop to lift the car bodies from the trucks. These take the place of the usual jacks and by their comparatively rapid operation save considerable time in handling car bodies.

To facilitate the movement of material to the balcony without taking it through the main floor of the shop and causing congestion, two 3,000-lb. elevators have been constructed outside the wood shop building. These enable lumber and other materials to be elevated on the outside and taken directly into the shop on the balcony level. The building is connected with the mill room, carpenter shop, blacksmith shop and car wheel shop via the transfer table.

The building is well-lighted by saw-tooth skylight con-

struction and two tiers of Truscon side wall sash which extend the full length of each side. To take care of the increased size of the car department, service and locker facilities are provided in an extension the entire length of the west side of the old coach shop, the most central location shops from station to station, as shown in the layout drawing, thus eliminating back travel and reducing lost time.

Specialized gangs become familiar with the work at their respective stations and, in addition, all the tools needed for the most efficient carrying on of that particular work are



Layout of New D. & R. G. W. Car Shops at Denver, Col.—Stations Used in Repairing Composite Gondolas Are

that is available to the workmen in this department.

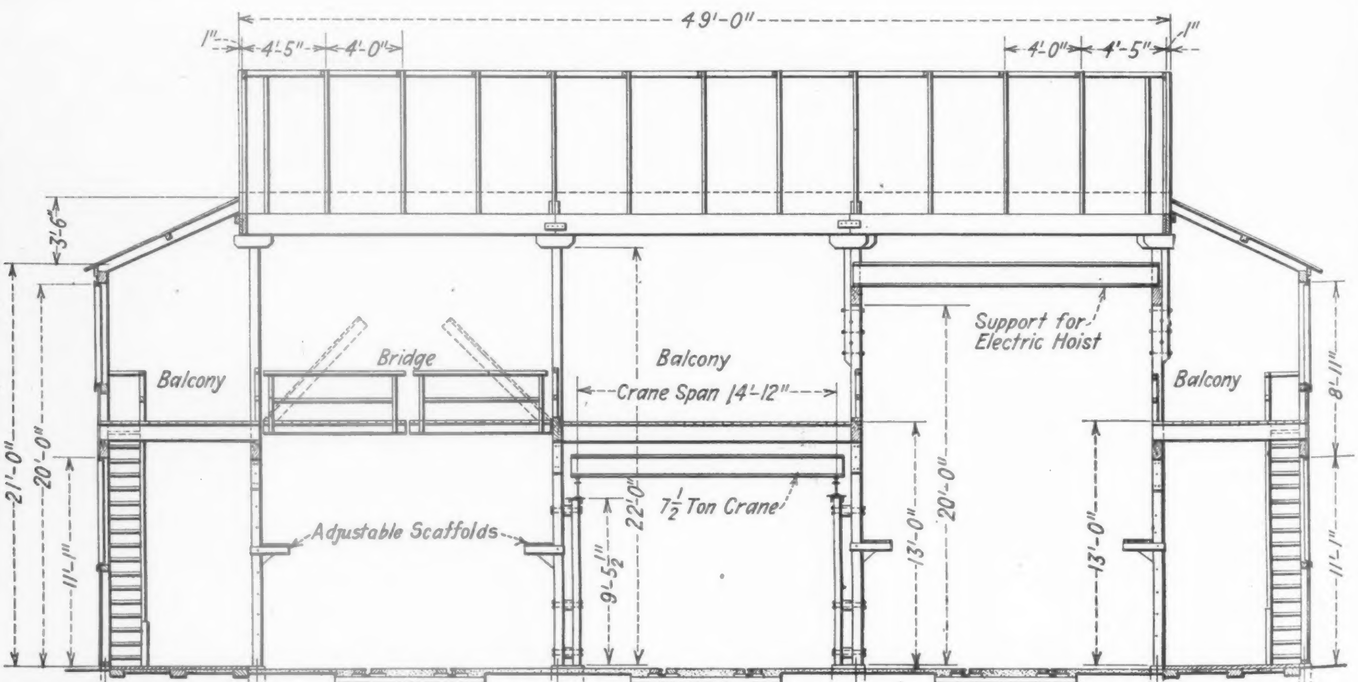
An effective exhaust steam heating system, made by the Bayley Manufacturing Company, Milwaukee, Wisc., has been installed and makes the shop a comfortable place in which to work in the winter. This feature, combined with good light and protection from the rain, is particularly appreciated by car repair men who were formerly compelled to work out of doors in all seasons of the year and under all weather conditions.

Both the steel and wood car shops are equipped throughout with air, electricity and oxygen and acetylene gas.

Work Carefully Organized

The main idea of the engineers in the design of the new D. & R. G. W. car shops was to provide equipment and a kept near at hand. Parallel track operation, provided also as shown in the layout drawing, facilitates the organization of competing gangs and moreover, when the car maintenance work must be curtailed, one side of the car shop can be shut down, maintaining the same maximum efficiency on the remaining track.

When all is in readiness to move the cars from one station to the next, six-foot cables are stretched between the couplers, and all the cars on one side are moved at the same time by an electric car haul. Evidently, therefore, each gang in the line must complete its work on time or hold up the entire movement. To provide for an unusual amount of work at any station and prevent shop delays from unexpected difficulties, floating gangs are available to help out at each point. The organization of the D. & R. G. W. car shop

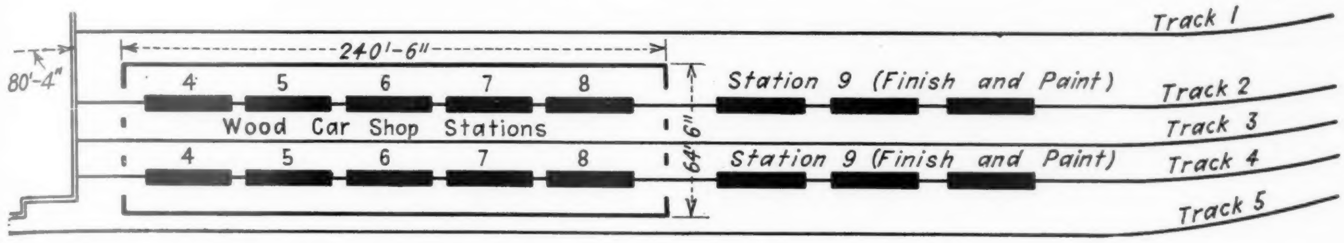


Section Through Wood Car Shop Showing Balconies, Lift Bridges, Electric Car Hoist Supports and 7½-Ton Truck Crane Over Center Bay

shop layout which would enable cars to be repaired in the least possible time consistent with good work and at the least cost. As large a number of men as can work together without interfering with each other are employed on each car all the time it is in the shop. Consequently, while the shops are relatively small, cars are put through rapidly and returned to service with the least possible delay. Both cars and material are given a straight line movement through the forces into friendly competing gangs adds greatly to the interest of the work and materially speeds it up.

Balconies Facilitate Work on Box Cars

One of the factors in the shop design enabling a large number of men to work on each car without interference is the balconies which are intended for a gang organized to manufacture and trim doors, handle roofing, running boards,

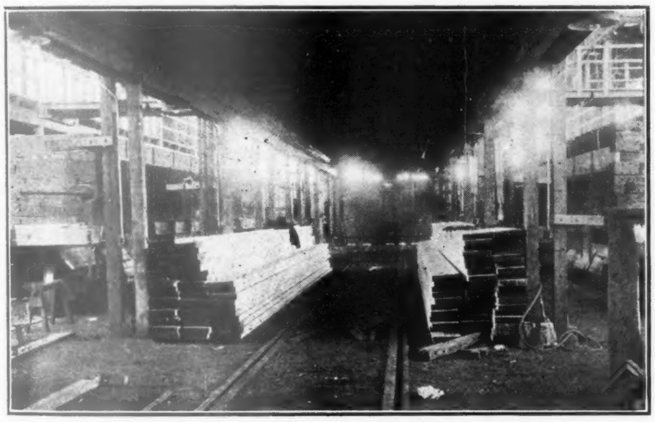


Indicated—Cross-Hatched Positions Are Used When Other Types of Steel Cars Are Going Through the Shop

saddle work, etc., on box cars. The balconies are at practically the same level as the car roof so that the gang which handles the work mentioned does not have to climb up and down ladders or scaffolds in doing it. Moreover, the balconies afford a considerable storage space for roofing material, running boards, carriage bolts, small castings, door fixtures, nails, etc., all of which material can be trucked to the balconies by way of the outside elevators without going into the shop at all on the main floor. The doors for the box cars can be lowered into place from the balconies by means of the electric hoists at the south end of the shop.

New Shop Organization Gets Results

The advantages of the D. & R. G. W. car shop layout and organization described were apparent from the first. A total of 648 flat bottom gondolas of 40-ton capacity practically requiring rebuilding, were lined up for the Denver shops. Of these cars 319 cars (Series 26,000) were equipped with drop bottoms, the other 329 cars (Series 27,000) being of the plain, flat bottom type. These cars were rebuilt with Symington type steel center sills, Farlow key-type draft gear and A. R. A. standard type D couplers. Necessary repairs were made to the trucks, but, for the most part, new sills, side stakes, planking and dump rigging were applied throughout. Some reclaimed material was used.



Center Bay of Wood Car Shop Served by 7½-Ton Box Crane for Handling Trucks when All-Wood Cars Are Going Through the Shop

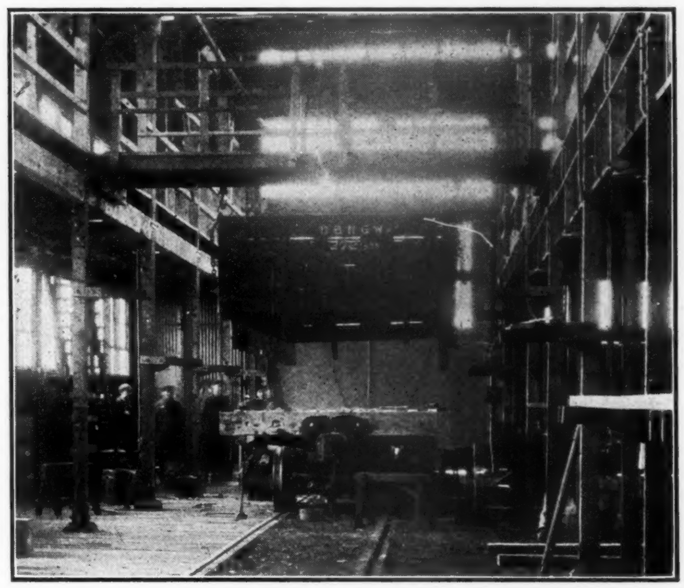
With 56 first class car men in the wood shop, 14 steel car men and 23 men in the stripping gang, three of these cars a day were put through the shops in March when the shops were first opened. In about three weeks, when the forces were better organized, the output advanced to six cars a day. The shops were at that time working eight hours a day, six days a week. When the output increased to six cars a day the wood shop force was reduced to 44 men, the output dropping to four cars a day. This was the mark originally set for both Denver and Salt Lake. The shops made a slightly better showing with the 27,000 class than with the 26,000 class cars for the reason that the latter have a considerable amount of dump shaft mechanism not on the former.

In planning for this method of car repairs, the designers contemplated careful scheduling of cars by classes and arranging for all repair materials based on careful inspection previous to shopping. Experience so far bears out the importance of making sure that all the material required for repairing a series of cars is ordered in advance and will be available at the shops when needed.

Route of Freight Cars Through Shops

All cars are received at the north end of the shops. Steel cars through the steel shop only; composite cars pass through the steel shop, over the transfer table, and through the wood shop; and all-wood cars pass through the wood shop only. At present the shipping track is also at the north end of the shop but eventually the tracks south of the wood shop will be straightened out to hold 10 cars each for painting and shipping. It is also the intention to straighten out the tracks north of the steel shop to hold 12 cars each for stripping.

While normally the cars move from station to station through the shops there is sufficient flexibility, particularly in the steel car shop, to permit of handling cars requiring a variable amount of work. Where composite or steel cars requiring work of the same nature can be lined up in sequence, they pass through the steel shop in progressive order on one or both of the through tracks. Where the amount of work is unequal, one or both of these tracks may be used in handling cars for heavy repairs, and other cars coming in at the north end can be repaired and moved ahead by the use of the traveling cranes. These cars are unwheeled at the north end of the steel shop, the trucks being repaired and replaced under the bodies at the south end. In this way, all-steel and steel underframe cars may be repaired at

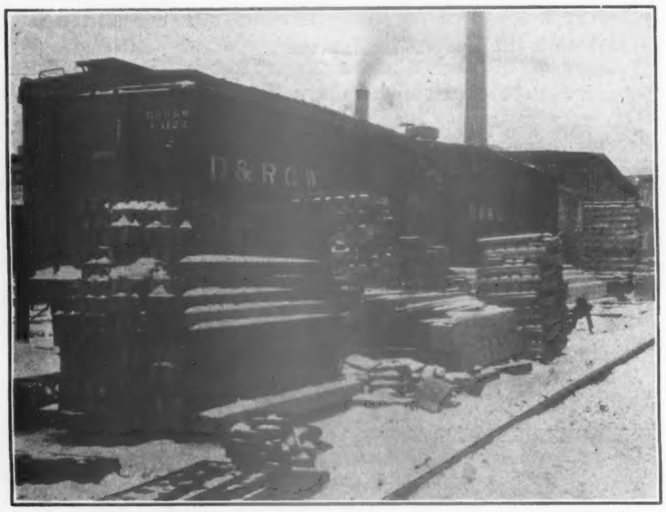


Gondola Sides and Ends Saved on This Car Being Reapplied to New Steel Underframe and Sills by Means of Electric Hoist

the same time. All-steel car bodies requiring straightening are moved into the shop at the north end, on the center track, on which is located the straightening frame already referred to.

Method of Repairing Flat Bottom Gondolas

The stations used in repairing the flat bottom gondolas referred to in this article are shown in the drawing. Station 1, north of the steel car shop, is used for stripping, this work being performed on tracks 2 and 4. Truck repairs are made just inside the steel car shop; the steel needle beams, body bolsters, draft gears and couplers are applied at Stations 2 and 3. Most of the steel shop machinery is located in the south end of the shop. The gondolas are advanced across the transfer table on their own trucks, passing consecutively through Stations 4 to 8 inclusive in the wood shop, during



Piles of Reclaimed Material Ready for Use

which time all wooden sills, side stakes, planking and drop doors are applied. Finishing operations are performed just south of the wood shop at Station 9 and one coat of paint is applied. The cars are then switched to the shipping track at Station 10, where a second coat of paint is applied, the cars stencilled and brakes tested. The detailed operations performed at each of the stations are shown in the following list:

Station 1 (north of steel car shop)—
Strip and dismantle cars complete.
Trucks placed on Tracks 2 and 4 just inside steel shop.

Station 2 (in steel car shop)—
Apply body bolsters and steel needle beams.
Fit up, drill and ream holes.
Rivet body bolsters and steel needle beams.

Station 3 (in steel car shop)—
Apply draft gears, keys and keepers.
Apply couplers.

Station 4 (in wood car shop)—
Apply all sills including steel.
Apply two sub sills.
Apply bolts to all sills.
Apply body truss rods and cotters.
Apply body truss rod saddles.
Apply end and side sill knee braces
Apply dump chain chaffing iron (32).
Apply body cross rods.
Apply end sill tie rods.
Apply brake staff bottom support bolts.
Apply striking blocks.
Apply body truss rod turn buckle board and cotter keys.
Apply wrought iron filler under body bolster and metal needle beams.
Hang side straps on cross rods.
Apply all bolts.
Apply all grip nuts.
Tighten all bolts.
Tighten uncoupling and casting bolts (eight).
Apply four sill steps.

Station 5 (in wood car shop)—
Apply header block caps.
Apply draft sills and inter sill fillers.
Apply air brake cylinder and bolts.
Apply air brake cylinder filler blocks (two).
Apply dump doors, hinge pins and cotter keys.
Apply decking and nail with Dayton nailing machine.
Tighten four bolster cross rods.
Apply side and end stakes.
Apply one bolt in each side and two bolts in each end stake.
Apply draft sill filler bolts.
Apply brake cylinder block split bolts.
Apply floating lever fulcrum and bolt.
Apply twelve lag screws. Inter sill fillers.
Apply pipe fitting for release valve.

Station 6 (in wood car shop)—
Apply all side and end plank complete.
Apply all inside and outside corner iron bands.
Apply all side stake hip straps.
Apply all side stake hip strap U-bolts.
Bore all holes in end and side planks with pneumatic tool.
Tighten side and end plank bolts with socket wrench.
Apply side sill and bottom end plank corner irons.
Apply six side grab irons.
Apply two end grab irons.
Apply safety lever pawl and space spools.
Apply safety lever pawl plates with eight machine bolts with grip nuts.

Station 7 (in wood car shop)—
Apply dump shaft filler blocks.
Apply dump shafts.
Apply dump shaft chain U-bolts with grip nuts.
Apply dump shaft front housing plank.
Apply dump shaft top housing plank.
Apply dump shaft top housing plank straps.
Apply four winding levers.
Apply four safety levers.
Apply eight dump shaft ratchet wheels.
Apply dump shaft winding lever brackets.
Apply four end grab irons.
Apply eight side grab irons.
Apply 32 dump door chains to dump shafts, 64 bolts.
Apply safety lever fulcrum pin bolt riveted.

Station 8 (in wood car shop)—
Apply cylinder and floating lever carriers.
Apply two top brake rods.
Apply two top brake rod carriers.
Apply one cylinder connecting rod.
Apply one hand brake rod and chain.
Apply one cylinder push rod.
Apply one cylinder lever.
Apply one floating lever.
Apply two uncoupling rods and Vilico uncoupling attachment.
Apply four uncoupling rod brackets.
Apply one brake staff.
Apply one brake staff top bracket and brake pawl.
Apply one brake staff top bracket filler block.
Apply one brake staff ratchet wheel and key.
Apply one brake staff wheel.
Apply one brake staff step board with two split bolts and six lag screws.
Rivet all safety appliance bolts.
Apply four end sill grab irons.
Apply one brake staff foot board grab iron.
Apply all brake connecting pins and cotters.
Apply two Acme pipe clamps.
Apply one retaining valve with two ⅜ in. bolts.
Apply two release rods, cotters and carriers.
Apply one release valve pipe bracket.
Apply two vertical grab irons.
Apply two vertical grab iron J-bolts.
Air brakes cleaned and oiled.
Apply brake pipe.
Apply brake pipe strainer.
Apply two 8-in. brake pipe nipples.
Apply two 1¼-in. self locking angle cocks.
Apply retaining valve piping complete.
Cut off ½-in. and ⅝-in. bolts with bolt clippers.

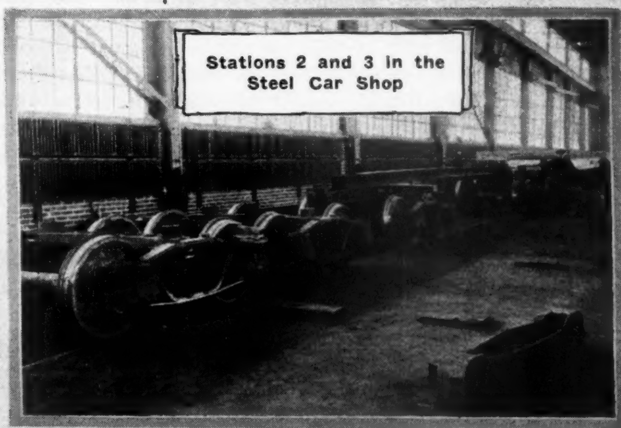
Station 9 (south of wood car shop)—
Apply one brake staff bottom support.
Apply brake staff cotter key.
Apply two end sill brake pipe holders.
Apply two carrier irons. Rivet onto steel center sills.
Steel men ream holes in wood shop for car men.
Where metal parts connect, paint with red lead.
All wood work, where covered with metal, painted with mineral paint.
All tenon and mortise joints paint with mineral paint.
Car receives first coat of paint.
Adjust air brakes.
Test air brakes.
Fit up pipe for air men in wood shop.
Apply end sill brake pipe holder U-bolts with grip nuts.

Station 10 (shipping track)—
Apply two bottom rods.
Apply missing or worn out brake shoes and keys.
Raise car to standard height.
Tighten bolts when overlooked in wood shop.
Adjust air brakes.
Test air brakes.
Apply second coat of paint and stencil.

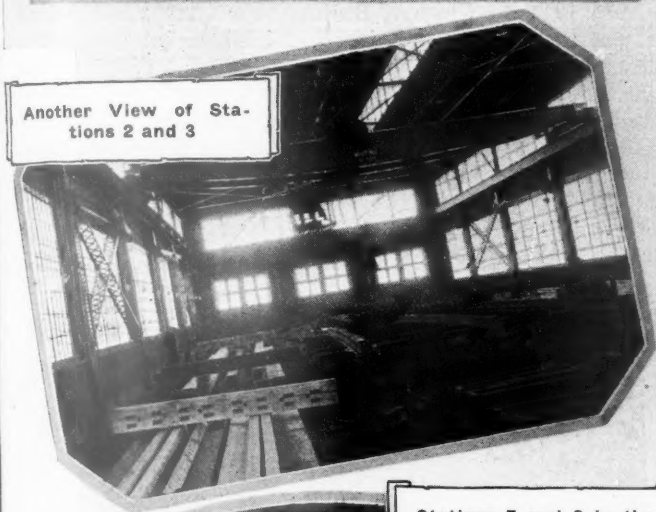
The forge shop and mill room work in conjunction with the car shop. All framing is done in the mill room, only the side and end planks being bored in the car shop proper. A Ford tractor and trailer system is used for delivering material to the men at the various stations.

Particular attention is paid to the reclamation of all scrap wood and metal parts capable of giving further service. The extent of this work will perhaps be indicated by the piles of reclaimed material shown in one of the illustrations. A special gang is used, with four laborers for stripping and handling wood and iron. Three laborers are employed picking up and sorting, nuts and washers; one man straightens second-hand bolts and another handles these bolts to the threading machine, later delivering them to the shop.

Stripping Station North of Steel Car Shop

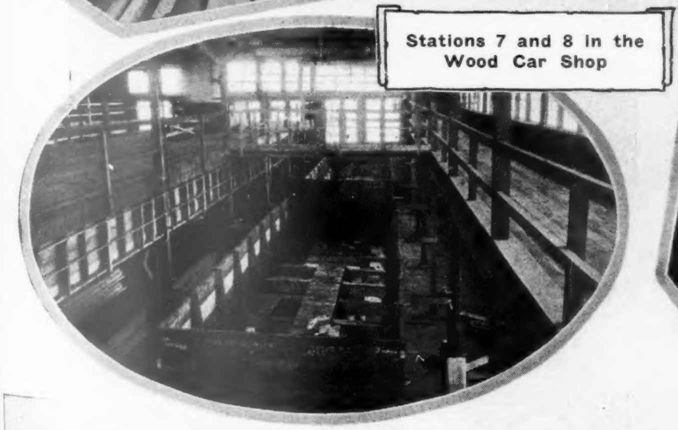


Stations 2 and 3 in the Steel Car Shop

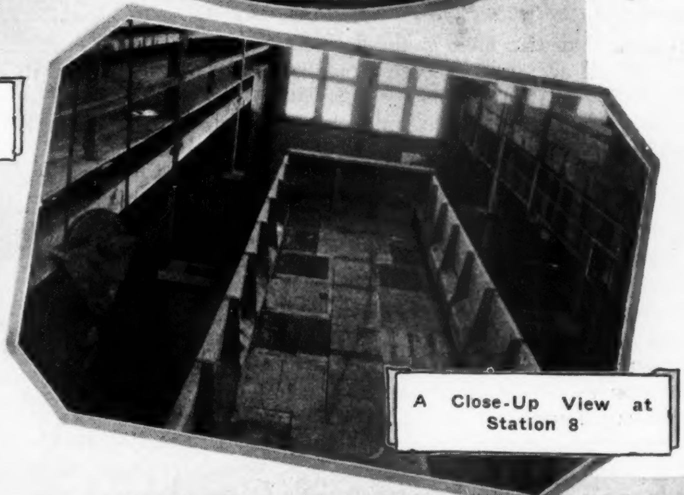


Another View of Stations 2 and 3

Stations 4 and 5 in the Wood Shop



Stations 7 and 8 in the Wood Car Shop



A Close-Up View at Station 8

Station 9 South of Wood Car Shop

Station 10—Shipping Track

A Story in Pictures of the Work Carried on at the Various Stations During the Repair of D. & R. G. W. Flat Bottom Gondolas

High Standard of Morale Maintained

The article would be incomplete without a comment regarding the high standard of morale evident among the car shop supervisors and men at the new shops. Almost without exception these are experienced car men who know what their work was like under former conditions and appreciate and are proud of the fact that they now work in modern, comfortable shops provided with the latest labor-saving equipment and devices. Perhaps the morale of the men is best shown by their willingness to adapt themselves to the new conditions and produce a good output. It is also shown by their interest in the prevention of accidents. Men in the car shop are doing their level best to get a better record in this respect than the men in the locomotive department. A record of all accidents is posted on the bulletin board shown in one of the illustrations. This record shows that in the month of March, for example, there were only two reportable accidents in the car department.

Safety First Board Showing the Record of Accidents in Various Shop Departments

The information and photographs presented in this article were secured by the courtesy and assistance of W. J. O'Neill, general mechanical superintendent of the Denver & Rio Grande Western, P. C. Withrow, mechanical engineer, B. F. Fry, general supervisor of car construction and repairs, and Battey & Kipp, consulting engineers, Chicago, who designed and constructed the new car shops, as a part of the rehabilitation program which also included the new D. & R. G. W. locomotive shops and engine terminals described in a previous issue.

Economic Value of Car Lumber Preservation

By F. S. Shinn

Supervisor, Treating Plant, Chicago, Burlington & Quincy

TODAY, when the railroads are being pressed more closely than ever before to show a return on their investment, it is imperative that every bit of material used shall be of such character that it will give the most economy. In connection with this many of the roads are going more and more to the use of steel cars, or at least putting steel sills in their wooden cars. There is no question but that timber is the best type of material for building cars due to the fact that it is cheap, adaptable and easily handled, but because of the fact that it rots quickly car builders have to a certain extent condemned wood and started using steel. The use of untreated timber for car material should be abandoned, but if we will use treated timber we will effect a larger saving than has yet been developed by any feature of car building.

Compiling data from many shop superintendents and car repair foremen, I submit the following facts: The average life of untreated car timber is as follows:

Stock car decking	2 to 5 years
Stock car sills	5 to 8 years
Stock car roofing	4 to 6 years
Flat car decking	6 to 8 years
Flat car sills	8 to 10 years
Box car sills	6 to 10 years
Refrigerator sills	4 to 5 years

Carefully kept records for a period of one year in one of the biggest car shops in the country has brought out the fact that 82 per cent of all timber removed from cars was removed on account of decay.

I have heard it said quite often that box car sills will not decay. The illustration (Fig. 1) does not bear out that statement. I have seen dozens of box car sills as badly decayed as the one shown. Stock car sills, stock car decking and refrigerator sills decay after only a few years' service.

In 1911 the Chicago, Burlington & Quincy began treating stock car decking and sills, and in that year built 200 new stock cars, using treated sills and decking. These cars are still in service with the original treated material, and in practically as good condition as when built. The average life of the untreated material is four years for decking and six years for sills, while the C. B. & Q. by treating it with the full-cell process with 12 lb. of creosote per cu. ft., has obtained 13 years' service and the treated material is still in good condition, so that it is safe to estimate that it will give an additional life at least again as long as untreated material.

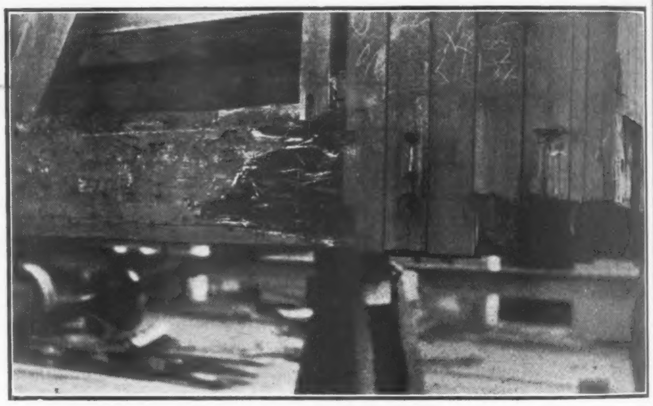


Fig. 1—Box Car of Untreated Lumber Built in 1916—Decayed Condition after Seven Years' Service

The economy of treating car material is brought out by the following example:

Cost of Stock Car Decking

648 bd. ft. (36-ft. car) at $47 per 1,000 bd. ft.	$30.45
Labor of laying deck on car	7.50
	$37.95
Treatment	21.64
Total	$59.59

The above cost of treatment is arrived at as follows:

12 lb. creosote per cu. ft. at 25 cents per gallon	$18.40
Charges for operating treating plant at 6 cents per cu. ft.	3.24
	$21.64
Untreated decking ($37.95) gives four years' life, or an annual maintenance of	$9.49
Treated decking ($59.59) gives 17 years' life, or an annual maintenance of	3.50
Saving per car on decking alone	$5.99

The above prices of material probably will not apply in all cases; that is, conditions may be such that these figures will be too high in some localities and too low in others. However, these figures may be used as a basis from which to work, showing that there will be a saving effected by the

treatment of car material, and anyone wishing to determine this saving should use the prices that apply in his particular case.

In the stock car (Fig. 2) note the decayed end sill; it is of untreated white oak. Note the side sill and decking; they are treated fir. The car was sent to the repair yard because the end sill became decayed after seven years' service.

Many people are reluctant to invest as much as $21 in the treatment of a stock car decking or any other material unless they know that they are going to get this money back in extra years service, and that of course should be the thought in every man's mind who is using treated material. The above facts, however, should be convincing as to the economy of treating material. There are several different processes of treatment not nearly so costly as the treatment used by the Burlington which will give very good results and which will at least double the life of the material—Empty-cell

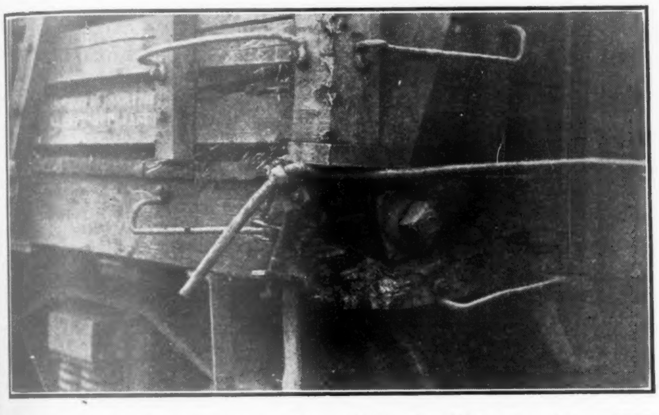


Fig. 2—Stock Car Built October, 1916—Condition in July, 1923. Decayed End Sill Is Untreated White Oak. Sound Side Sill and Decking Are of Treated Fir

(creosote), Card (creosote and zinc chloride), and Burnettizing (zinc chloride)—as well as with the more expensive full-cell creosote process.

Treatment by any of the above processes will resist decay, if not definitely prevent it, and if we will check this decay we are going to get very much longer life out of our car material. One of the big troubles that is being used as an argument against the treatment of car material as I see it is the fact that many of the railroad shopmen from the superintendent down either fail to see or will not admit why car material really fails. Most of them say that it fails mechanically, when the real reason is that decay has weakened it beyond the safety point, and it cannot stand up. The early stages of decay are practically impossible for the layman to detect, but while still in its early stage rot will weaken wood to such an extent that it will reduce its strength as much as 50 per cent. A good preservative treatment will prevent this incipient decay.

Recent Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Responsibility for Repairs to Safety Appliances

The Missouri Pacific rendered a bill against the Lehigh Valley on October 2, 1922, for the value of one brake staff complete with brake wheel and ratchet wheel on account of this equipment being missing from Lehigh Valley flat car No. 9817. The owners contended that a brake staff could not become missing in fair usage and that the staff had probably been taken off and lost while the car was being loaded or unloaded. It claimed that Rule 32 provided for the removal or cutting out of material from cars to facilitate loading as a handling line's defect and this rule also applied to brake staffs. The Missouri Pacific contended that it had no knowledge of the brake staff being removed to facilitate loading or unloading and it did not think it should be held accountable under Rule 32, as that a missing brake staff is listed as an owner's defect under Rule 33.

The following decision was rendered by the Arbitration Committee: "Under Rule 33 owners are responsible for expense of repairs to safety appliances where not involved with other delivering line damage. Therefore, the bill of the Missouri Pacific is correct.—*Case No.* 1298, *Lehigh Valley vs. Southern Pacific.*

Rule 120—A Change of Prices Before Repairs Are Completed

Under date of July 3, 1920, the Southern transmitted to the Southern Pacific a joint inspection certificate covering the condition of Southern Pacific car No. 79848 and asked the disposition of it under Rule 120. The estimated cost of repairs as shown on the joint inspection certificate amounted to $243.02. The Southern was authorized under date of July 12, 1920, to repair the car and render a bill for it. The handling line presented to the car owner a bill amounting to $432.45 for repairs made on authority of a repair card issued at Alexandria, Va., September 25, 1920. Allowing the $50 excess cost over the estimate as specified in Section (d), Rule 120, there was an overcharge of $139.43. The car owner requested counter-billing authority for the overcharge, but this was declined by the handling line on the grounds that the overcharge was due to increased prices for labor and material as specified in Supplement No. 3 to the 1919 Code of Rules, under which the repairs were priced, while the estimate submitted to car owner under date of July 3, 1920, was based on rules in effect on that date. The car owner claimed that if it had known that the total cost of repairing the car was to be so high it would have authorized dismantling it. The handling line contended that the car owner, having knowledge of the increase in prices for labor and material should have determined at once whether or not there would be an increase in cost of repairs and requested additional information, if necessary. The repairing line claimed that, owing to the large number of cars on hand for the car owner at the time, it was unable to make repairs promptly. As a result the repairs were not completed until September 27, 1920, or subsequent to September 1, 1920, at which time A. R. A. prices for labor and material were increased, which resulted in the increase for the total amount of repairs. No additional items were added to the repairs shown on the inspection certificate.

It was decided by the Arbitration Committee that the charge of the Southern Railway, based on prices in effect at the time repairs were completed, should be accepted insofar as the increased prices are concerned.—*Case No.* 1299, *Southern Pacific vs. Southern.*

Acceptance of Bad Order Cars by the Owner

In the early winter of 1920 numerous Maine Central and Bangor & Aroostook freight cars were moved over the Boston & Maine lines to Portland, Me., for delivery to the owners, bearing cards attached by other roads showing that they were sent home for repairs. The Maine Central was also delivering to the Boston & Maine at Portland, various foreign cars

to which similar cards had been attached by the Maine Central, in order that they might be moved to the home roads for reconstruction or demolition. The Boston & Maine later on refused to accept from the Maine Central foreign cars for movement to the home road for repairs, it being understood that this order was issued on account of the refusal of the Delaware & Hudson to accept such cars from the Boston & Maine for movement over its line towards the home road. On account of this order, the Maine Central on December 31, 1920, notified the Boston & Maine that it no longer desired to have its own cars accepted and moved to the home road for repairs unless the Boston & Maine was in a position to accept foreign owned cars from the Maine Central for movement to their home lines. Notice was at the same time given to the Boston & Maine by the Maine Central to the same effect with respect to the cars owned by the Bangor & Aroostook, which road had notified the Maine Central that it was not willing to have its cars moved home without authority issued by itself.

The Maine Central contended that Interchange Rule No. 2 provides that owners must receive their own cars when offered home for repairs at any point on their line, subject to the provisions of the rules. Rule 120, however, provides a method by which the owner may determine disposition of a car which requires general repairs, due to the owner's defects. The evident purpose of this rule is to provide for necessary repairs without home movement and to give the owner an opportunity to decide whether or not the cars are worth the expense necessary to return them to service in good condition. There is nothing in the Rules of Interchange which prevents any railroad handling defective cars at its own expense toward the owning road, neither is there anything in the rules which requires any road to move foreign cars home for repairs at its own expense. The Maine Central maintained that it was entirely within its right under the Rules in notifying the Boston & Maine to discontinue acceptance of its cars in bad order for delivery home as long as the Boston & Maine was not in a position, or was unwilling, to accept cars belonging to other roads which were in the possession of the Maine Central, and which must either be sent to the owner or handled under Rule 120 by the Maine Central.

The Boston & Maine maintained that Rule 120 was devised to give the holding railroad an opportunity to obtain authority from the owner of a car which, in its opinion, required repairs extensive enough to warrant its destruction, to destroy the car rather than to go to the expense of handling the car to the owner for such destruction. If the holding road desires to assume the responsibility and the expense of moving cars in general bad order to the owner, the owner has no right to refuse his own property provided it complies with the I. C. C. Safety Rules.

The matter was referred to the Arbitration Committee which rendered the opinion that the Maine Central was not within its rights in notifying the Boston & Maine not to accept from its connections Maine Central and Bangor & Aroostook bad order cars home bound.—*Case No.* 1,300, *Boston & Maine vs. Maine Central.*

Responsibility for Damaged Car

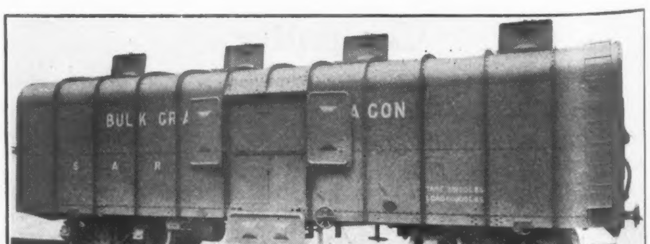
On November 2, 1922, while Seaboard Air Line car No. 16631 was being hauled in a Detroit, Toledo & Ironton train, upon its arrival at Springfield, Ohio, it was found to have six sills broken and various other defects, making it necessary for a statement to be furnished according to the footnote under Rule 43, as the handling line reported the car under Rule 120. The handling line was unable to advise the exact circumstances under which the car failed and, therefore, the car owner held it responsible for the damage to the car. The handling line reported that upon inspection it was found that the defects were the result of the decayed and weakened condition of the car and that personal investigation proved that the car had in no way received rough handling while in the train. However, the handling line admitted that it was unable to state just where the car failed. Again, on November 29, the owner received a request for disposition of the car in accordance with Rule 112, to which was attached the inspection certificate enumerating the defects. The handling line was advised that Rules 112, 120 and the footnote to Rule 43 had not been complied with. A representative of the owing road inspected the car at Springfield, Ohio, on March 17, 1923, and developed the fact that the breaks in the longitudinal sills were new defects apparently caused by rough handling. He also found that the car in question was overloaded according to Rule 86. The light weight of the car was 37,500 lb. and the net load 64,370 lb., giving a total of 101,870 lb., whereas the weight allowed by Rule 86 was 95,000 lb. gross. The car was therefore overloaded 6,870 lb.

The Arbitration Committee rendered a decision to the effect that the handling line is responsible on account of the failure to furnish a statement showing the circumstances under which the car was damaged, as per footnote to Rule 43. Arbitration Cases 1219 and 1283 are parallel.—*Case* 1302, *Detroit, Toledo & Ironton vs. Seaboard Air Line.*

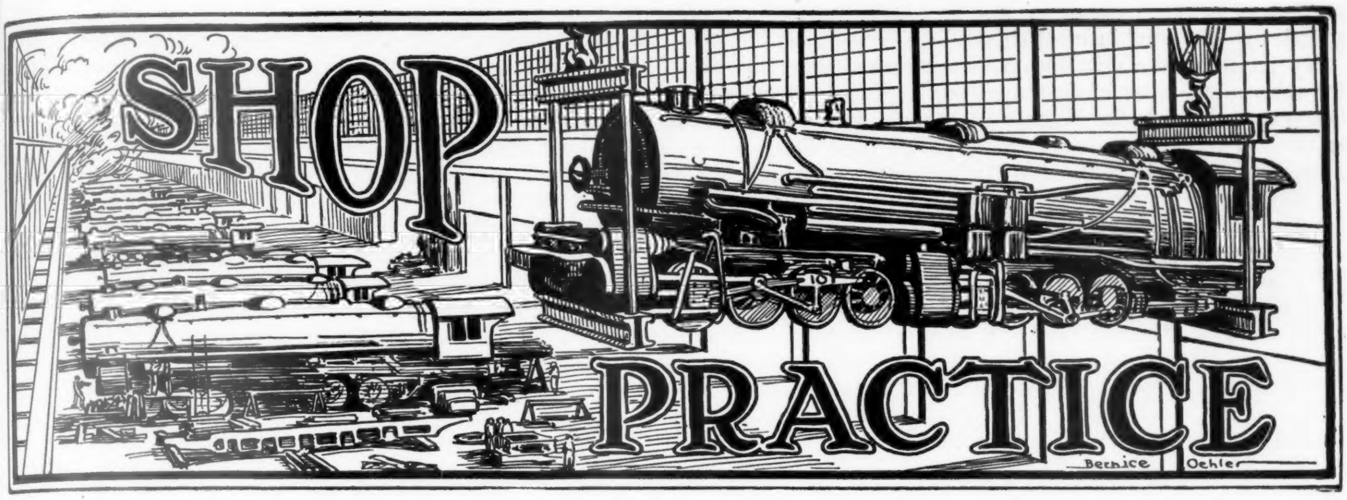
Responsibility for Damaged Car

On October 27, 1922, Seaboard Air Line flat car No. 43573 broke in two while in switching service on the Southern. On November 10, 1922, an inspection certificate showing in detail the condition of the car, was sent to the owner with a request for disposition in accordance with Rule 120. The owner declined responsibility on the grounds of unfair usage in service. The Southern notified the owner that the damage to the car was not the result of unfair usage. Car No. 43573 was a 60,000-lb. capacity, 40-ft. wooden flat car, weighing 27,000 lb., built originally in September, 1906. It was rebuilt in March, 1918, and equipped with short wooden draft arms and Farlow draft gear. The handling line contended that the failure of the car was the direct result of its light capacity, length and generally worn out condition. The car owner stated that it should have received a request for disposition of the car on October 27 instead of November 10, and that the handling line should have furnished a statement as to when, where, and how the car was damaged, in accordance with the note to Rule 43, so that the owner could advise the disposition of the car. The owner claimed that nobody on the handling line could explain how the car was damaged.

The matter was referred to the Arbitration Committee, which rendered the following decision: The handling line is responsible on account of the failure to show the circumstances under which the damage occurred, as per footnote to Rule 43. Arbitration cases 1219 and 1283 are parallel.—*Case No.* 1301, *Southern vs. Seaboard Air Line.*



Bulk Grain Wagon for End or Bottom Discharge Built for the South African Railways by The Leeds Force Co., Ltd., Leeds, England



Handling Driving Box Work*

The Proper Layout of Machine Tools and the Use of Special Fixtures Speeds Up Production

By J. H. Hahn
Machine Shop Foreman, Norfolk and Western, Portsmouth, Ohio

THE one most important feature in the handling of driving box work is the grouping of the machine tools and other equipment such as the bronze furnace, lye vats, etc., in a way that the handling of the boxes from one operation to another will be reduced to a minimum, thereby saving considerable time and labor in the process of overhauling after they have been removed from the locomotives, as well as in the manufacture of new driving boxes. Fig. 1 shows the grouping of machines for handling this work in the shop at which the writer is employed. The distance that

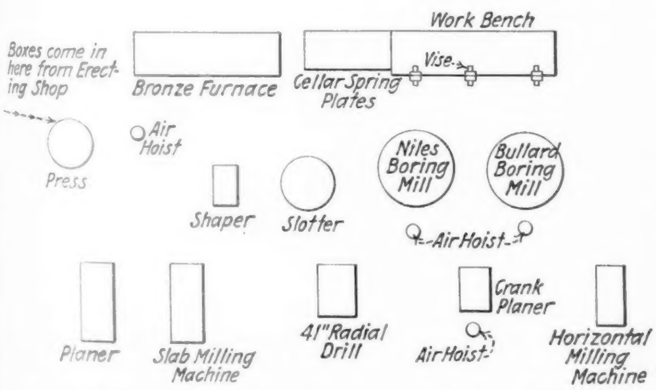
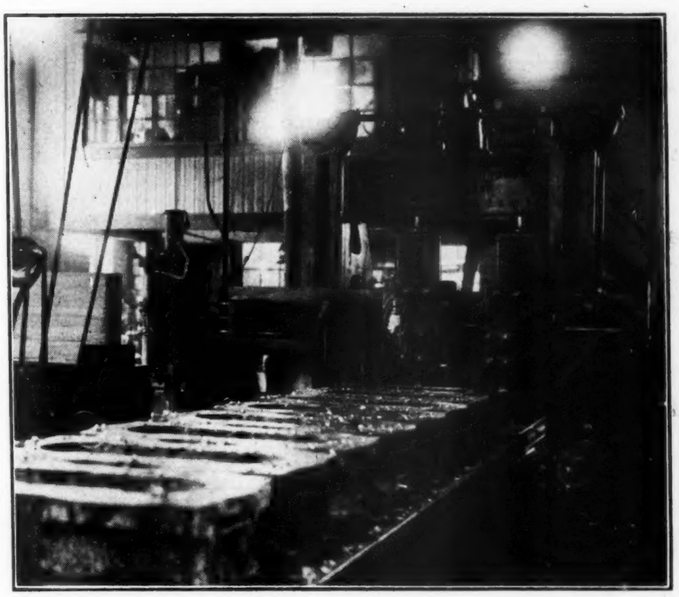


Fig. 1—Layout of Machine Tools in the Driving Box Gang

a driving box has to be trucked from the time that it is removed from the locomotive until it is ready to be replaced again has been reduced from about 2,000 ft. to less than 250 ft. In other shops that have recognized the value of grouping machines in this manner the distance has been cut from 5,600 ft. to about 300 ft. In making a check of our driving box work the first thing we did was to measure the distance that a driving box was traveling in our shop from the time it was removed from the locomotive until it was repaired and ready to be replaced on the journal. When we found that this distance was excessive we corrected the condition by rearranging and grouping the machines in the driving box gang. There is much room for improvement in this respect in a good many shops that the writer has worked in or



Boxes Are Set Up on Planer in Lots of 24 or More at One Time

visited, and we are glad to note that many of the shops are realizing the importance of grouping their machines and handling the work in such a manner that time and labor will be saved in the various operations involved. Fig. 1 also shows the various machines that are used in doing this work, and while the minor operations on driving boxes may differ

* Awarded the prize in the driving box production job competition which was announced in the February *Railway Mechanical Engineer.*

somewhat in the various shops the major operations are practically the same in most shops.

By grouping the machines and other equipment the time for scheduling a set of driving boxes for a certain class of locomotive through the shops may also be decreased considerably. The driving box work is handled on this road by a regular schedule which is posted in the machine shop weekly and is taken from a master schedule board which does not differ much from those in use on other roads using a scheduling system.

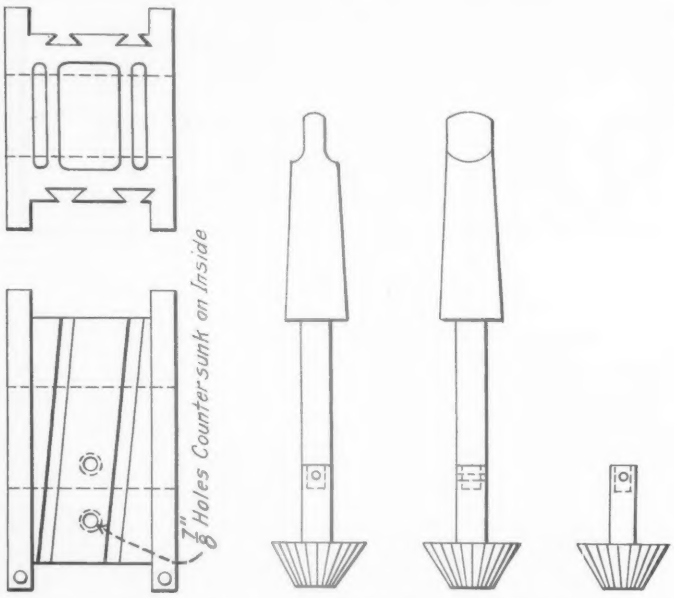


Fig. 2—Showing Method of Dovetailing Boxes and the Special Tool for Countersinking Anchor Pin Holes

Thorough Inspection Essential

After the boxes are removed from the wheels they are conveyed to the lye vat on electric trucks, where they are thoroughly cleaned and then transferred to the machine shop by truck. After reaching the machine shop a machinist and one helper inspect all boxes closely for cracks, loose crown brasses, worn crown brasses and other defects. All boxes are properly stenciled and recessed for collars on the crown brasses. If the brasses are to be renewed they are pressed out of and into the driving boxes on a press designed and constructed on this road for such work which is used as standard on account of the limited floor space it requires.

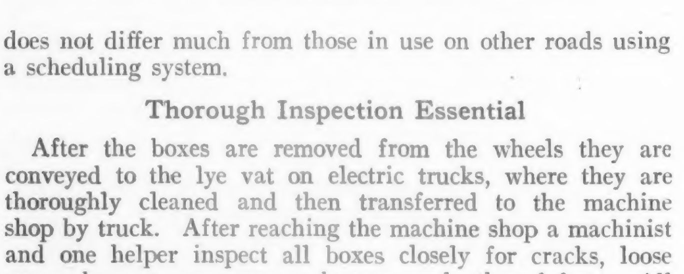


Fig. 3—Special Form Used for Bronzing Driving Boxes

All crown brasses that are thick enough and tight in the boxes are rebored and put back into service. All boxes are calipered for being parallel on the shoe and wedge faces and those that are tapered or require planing for other reasons are trued up on a Newton 32-in. crank planer. The limit for wear on the shoe and wedge faces of the boxes is set at ¾ in. or ⅜ in. on a side for the reason that we cannot bronze a box and get good results on anything less than ⅜ in. and all boxes are rebronzed and planed to standard after reaching this wear limit. No driving boxes are welded up and all cast iron boxes are scrapped and cast steel boxes used to replace them. The limits for thickness of the crown brasses, if tight in the boxes and in good condition, is ⅜ in. for boxes for heavy Mallet locomotives and ¼ in. for the Consolidation and smaller locomotives.

When a box has been reduced by wear to ⅜ in. below the original or standard size it is grooved and dovetailed, as shown in Fig. 2, and anchor holes drilled. This method of grooving driving boxes is used because it can be done at one set-up and prevents the bronze from working out if it should get loose, as the general tendency is for the bronze liner to work up, and this upward movement tightens the bronze in the grooves. The special countersinking tool shown in this illustration is used to countersink the holes from the inside which anchors the bronze firmly. The holes are drilled from the outside with a jig to insure getting them in line, the countersinking tool is inserted and the shank entered as shown and the operation of countersinking the holes from the inside is quickly done.

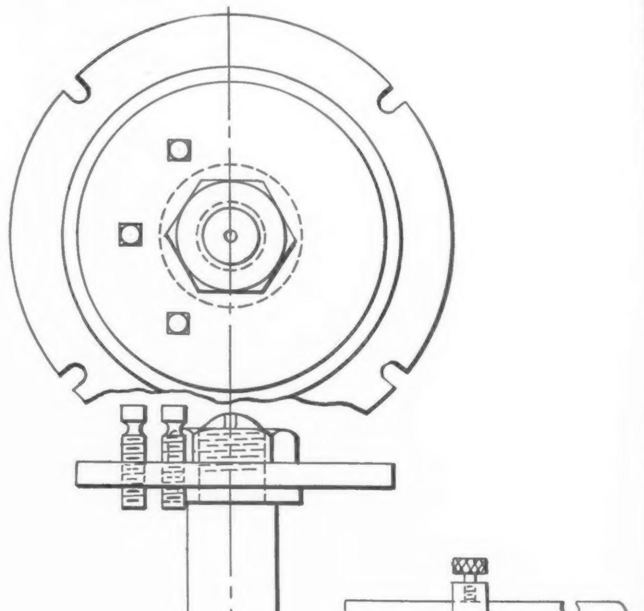


Fig. 4—Mandrel Used on Boring Mill For Turning Crown Brasses and Gage for Setting Brasses

Bronzing Repaired Boxes

Fig. 3 shows a special form we use for bronzing the driving boxes. This is done in order to get the boxes as near the finished sizes as is possible and get them smooth and

uniform. We find that from 10 to 30 min. per box can be saved in the total time for machining, and much better results can be obtained both in the bronzing room and in the machine shop. The form can be put on a box and removed in a few seconds; in fact, when working piece work the men prefer this form to the old method of pouring the bronze on the boxes. The form is held in position by tapered pins and the two set screws shown at the top are tightened up slightly. The forms can be easily and quickly made for all sizes of boxes and are inexpensive.

After the driving boxes have been inspected, those that are undersize are grooved and then bronzed with the special bronzing fixture shown in Fig. 3. The crown brasses are then turned on a Niles 36-in. boring mill on the special mandrel shown in Fig. 4. This mandrel has several good features. It will take the various sizes of crown brasses by merely changing the plates which are keyed to the spindle, and it is equipped with a set-up gage that enables the machine operator to set the brass before the machine is started. With this fixture an ordinary crown brass can be turned and chamfered in from 10 to 14 min., including setting up and turning the collars.

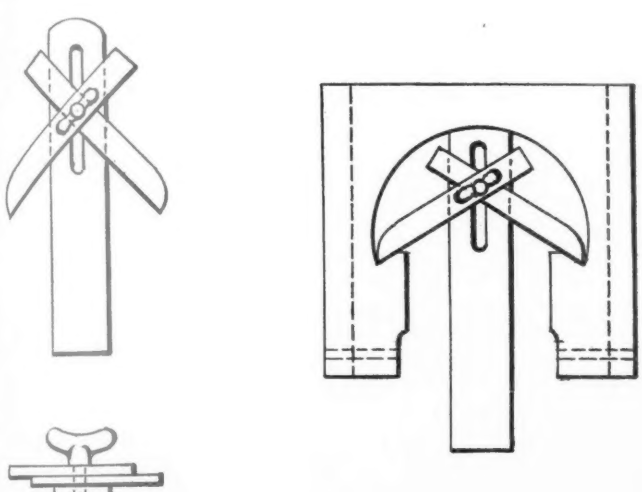


Fig. 5—Crown Brasses Are Laid Off with This Gage

After the brasses are turned they are laid off with the gage shown in Fig. 5, and then they are slotted on a 24-in. Dill slotter in a special fixture. There is no time lost in setting up these brasses as this fixture clamps the brasses square with the backs and they are slotted with a special tool that makes the radius on the brass at the same time that it is slotted for a fit in the boxes.

The methods of handling driving box work will differ somewhat, as opinion differs. The practice on some roads is to fit the crown brasses in such a manner that the grain will run across the grain in the driving boxes. This method is used on this road as there is a general opinion that this method produces better results in that the brasses when applied in this way remain tight in the box and the percentage of loose crown brasses is very low. All crown brasses are applied with collars, and no pins are used.

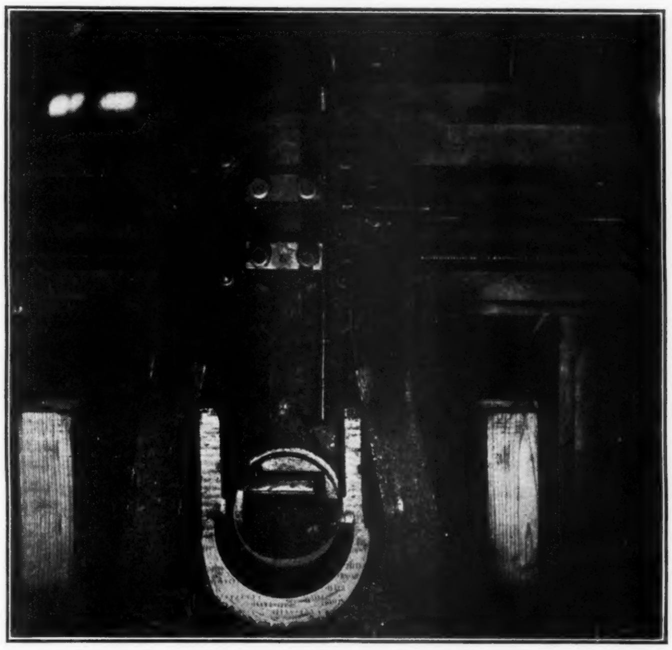
Some of the boxes have the bronze liners cast on the hub faces. These are applied by grooving and dove-tailing the boxes and pouring the bronze on them, after which they are faced for lateral on a Bullard driving box boring machine. Several anchor holes are also drilled in the faces of the boxes before they are bronzed. All driving boxes are faced while being bored at the one operation and are carefully checked after they are bored with the gage shown in Fig. 6. The limit on this check is 1/64 in. out of center. All boxes for heavy Mallets are bored 1/32 in. larger than the journals, the others are bored 1/64 in. full larger than the journals. All boxes are relieved on the edges of the crown brass bore with a special tool while on the Bullard box mill, and the boxes are ready to apply to the journals as soon as oil grooves are chipped, no filing or fitting being done on the boxes in the erecting shop.

Organization of the Work

The different machines used for driving box work are shown in Fig. 1. All of the work on the driving boxes is done within the space shown, which reduces to a minimum the handling of the boxes for the various operations. The horizontal mill is used for milling the spring seats, for milling the grease cavities in the crown brasses and for boring the radius in the driving box cellars for the journals. The other machines are the usual machines found in most shops for handling this class of work.

All boxes are fitted complete in the driving box gang. Cellars, cellar bolts, spring plates and perforated plates are applied before the boxes are sent to the erecting shop. Boxes are delivered to a designated location in the erecting shop by the transportation trucks. Hooks are used for lifting the boxes with the cranes and placing them on the journals. These hooks fit into the oil holes on the shoe and wedge faces of the boxes and facilitate safe handling. We find that a good set of driving box hooks for each machine saves considerable time and prevents a good many accidents.

All crown brasses, boxes, cellars, etc., are properly stencilled and fitted up in the machine shop. One machinist and a helper will take care of from 6 to 12 engines per week by a systematic layout and good facilities for handling the work. In shops where piecework rates obtain for this work it is essential that special tools, jigs, fixtures, etc., be employed, and much attention should be given the matter of grouping machines, and bringing the work together in such a way that all lost motion may be entirely eliminated. This matter requires close study and constant attention.



Special Tool for Planing Radius for the Crown Brass Fit

The boxes can be finished on the shoe and wedge faces after crown brasses have been applied by placing a set on each side of the planer table clamped to a special fixture. The Ingersoll planer type slab miller can be employed to good advantage in machining the boxes on the shoe and wedge faces after they have been bronzed. This work is handled mostly by one operator and a helper; the helper removes and replaces the boxes as soon as they are com-

pleted. The usual design of fixture furnished by the makers of the machines is employed for holding the driving boxes.

The grease cavities in some cases are cast in the crown brasses and in others they are milled, using the horizontal boring mill and a 1½-in. right hand end mill for this operation. We find that milling the grease cavities gives a brass absolutely free from core sand and tends to prevent hot box trouble.

Blank forms are filled out by the inspectors when checking driving boxes and the journal sizes are furnished to the men on the boring mill and also to the man who fits up the cellars. These forms are filled out after the wheels pass through the wheel gang and journal lathes. The forms are then filed away with the other reports for future reference and check

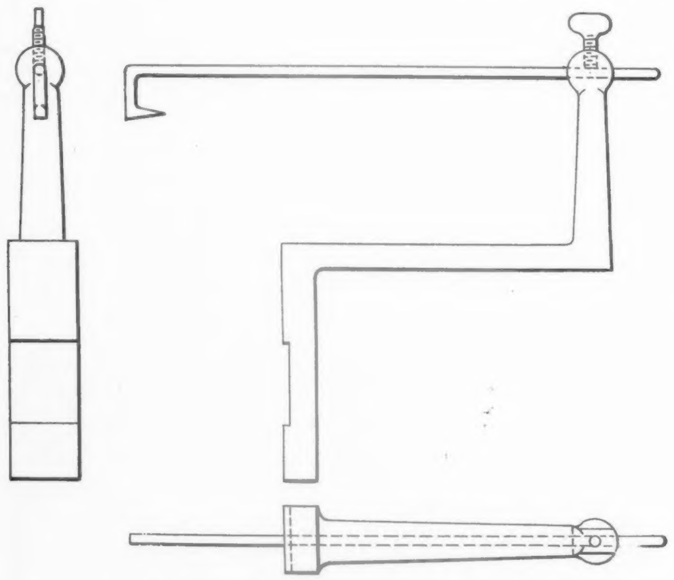


Fig. 6—Gage for Checking Crown Brass Bore

on the work that was done on the driving boxes while the engine was in the shop.

The layout of machines shown is sufficient to take care of from 15 to 25 engines per week working two shifts on some of the machines when necessary. This work, of course, includes simple engines for which 6 to 8 driving boxes constitute a set, and some of the heavy Mallet locomotives which have 16 boxes to the set.

Work on New Cast Steel Driving Boxes

All driving boxes being applied now on this road are of cast steel and the boxes are delivered from the foundry in carload lots to the machine shops. They are planed and faced to proper dimensions and are handled in lots of from 24 to 48, depending upon the size. After the boxes are faced they are set up on the planer bed in lots of from 12 to 16 or more, and the radius for the crown brasses is machined with the special tool shown in one of the illustrations which was designed at the Portsmouth shops. The idea of this bar is by no means a new one. However, the bar itself is entirely new in design as no bevel gears are used in the feed shafts, all parts of the bar proper being operated by a worm and worm wheel. The bar has a heel brace of very heavy construction to withstand the strain due to the long over-hang of a tool of this kind. The next operation is to machine the cellar fit with the special tool shown in Fig. 7, both sides being machined at one time. This tool is very simple in design and is of heavy construction to take care of the long overhang.

Next, the boxes are recessed on the boring mill to accommodate the collars on the crown brasses and then the brasses, which are turned on a special mandrel, are pressed in. The boxes are then planed ¾ in. below finished sizes, and are dove-tailed, grooved and bronzed, these operations being the same as for the old boxes and using the same jigs, tools, etc. After the boxes are dove-tailed the anchor holes are drilled and countersunk from the inside. Spring saddle seats are milled on all boxes to insure the spring rigging being level.

When pressing in crown brasses a pressure of from 15 to 25 tons is applied, depending upon the size, construction and general design of the box. No boxes are opened up with spreaders prior to applying crown brasses, as it has been found that this is not good practice. All crown brasses are machined to fit the boxes properly, no brasses are shimmed when new and special attention is given the fits on the lips of the crown brasses to insure proper radii on corners. No plugs or pins are used as retainers for the crown brasses as it has been found that it is not necessary to use them when the brasses are applied with the collars, or flanges.

Conclusion

The material used on new work is drawn from the storehouse and is delivered to the machine shop by the trucking system and the men who do the driving box work do not lose any time in going to and from the storehouse for material. This is an important feature in connection with the handling of this work, which keeps the men on the job and saves time. The tendency for men to walk around the shops from place to place for material, etc., can be eliminated by bringing material, sizes, reports, tools, etc., to them.

Analyze your driving box work, look around and see what

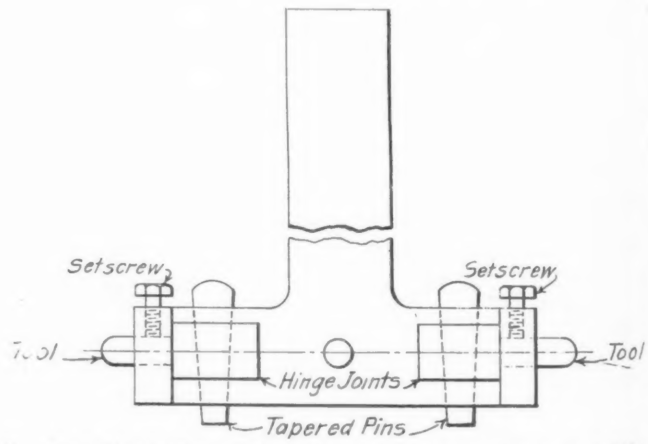
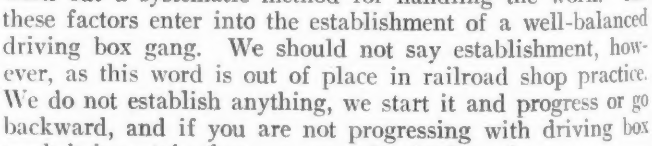


Fig. 7—A Simple Tool Designed to Machine Cellar Fit in Both Sides of the Box at One Operation

the other fellow is doing, see the results that he is getting and compare the number of engines you handle, the facilities you have, the number of men employed on this work and the source of supply for material for doing the work, and then work out a systematic method for handling the work. All these factors enter into the establishment of a well-balanced driving box gang. We should not say establishment, however, as this word is out of place in railroad shop practice. We do not establish anything, we start it and progress or go backward, and if you are not progressing with driving box work it is certain that you are going backward.



Mikado Locomotive Built for the Sudan Government Railways by Robert Stephenson & Co., Ltd., Darlington, England; Gauge 3 ft. 6 in.

Application of Micrometers in Railway Shops

Interchangeability of Locomotive Repair Parts Is Made Possible by Using Accurate Measuring Devices

Part II

By M. H. Williams

LOCOMOTIVE repair work is peculiar owing to the fact that the men must change from one job to another several times a day. Owing to the wear of certain locomotive and car parts it is necessary practically to machine each repair part to fit into worn parts that are of different sizes. As a result, there are very few duplicates handled per day. This lack of duplication, which is a necessary evil that cannot be avoided, serves to bring out the fact that careful consideration should be given to the small hand tools, shop kinks and micrometers, in order to reduce all possible lost time when measuring, traveling from the machines to the locomotives and the hundred and one little delays that eat up time.

Measuring a Crank Pin with a Micrometer Caliper

It is becoming more and more the practice in railway shops for certain designated men who may be known as gang foremen, inspectors or checkers, to inspect the worn parts of the locomotives and pass on the grading and necessity for making repairs. These inspectors in many cases measure the worn parts and mark on prepared blanks the sizes to which the new or repaired parts should be finished. These blanks are handed to the machine operators who finish the repair parts to the sizes called for. The added cost of these inspectors is discounted several times over, by the decreased cost of machine work and fewer spoiled parts.

Locomotive repair work, as is well understood, calls for several classes or kinds of fitting. Axles and bushings must be forced off and shrunk into place and may be, depending on the nature of the material, anywhere from .002 in. to .020 in. larger than the hole. Valve motion lever pins are generally between .003 in. and .006 in. smaller than the bushings and driver boxes are bored about .020 in. larger than the axles. By providing the necessary measuring instruments, gages, micrometer calipers, etc., for both the inspectors and the machine operators, the required drive, neat, running or loose fit can readily be made by the workman from the sizes shown on the blanks without going to the locomotive or place where the part so finished is to be used.

In order that a man in one part of the shop shall be in a position to make an article that will properly fit in the locomotive frame, wheels, or air brake equipment that may be in another part of the shops, the measuring devices must be accurate, of a nature not requiring any particular skill in their use and of light weight so that the inspectors may readily carry the necessary equipment from one point in the shop to another.

Measuring Locomotive Driver Axles and Boxes

In certain railway shops, the art of boring driver box shells or crown brasses such as used for repair work has been so perfected that it is not necessary to scrape, file or spot the driver box on the axles. The side wearing surfaces are machined to the correct dimensions at the same time as the boring operation. This, as will readily be noted, saves considerable labor and delay. With some of the modern driver box boring mills the boxes are bored and faced to correct dimensions without delaying the machine operation for the purpose of measuring. The only measurements made are after the completion of the finishing cut which is for the purpose of checking the correctness of the work. In every day repair practice where scarcely two journals are of the same size, practically all boxes are bored within a limit of plus or minus .005 in. of the desired size. This desirable practice has been made possible owing to the use of micrometer calipers, special micrometer gages and micrometer dials on the boring mills.

The operation of measuring the diameters of axles and the distance between wheel hub faces is as follows. When inspecting the axles, the diameter of the journals are measured with micrometers, preferably similar to that shown in Fig. 1, although the regular micrometers without the additions for squaring are frequently used.

When the wheels arrive in the wheel shop, if the journals are not cut or rough, the inspector measures the journals to ascertain the amount they are worn out of round or tapered for the purpose of determining as to the necessity of returning or passing. If a single journal is in good condition and less than .030 in. out of round or tapered, it would be considered satisfactory for service. If this limit has been exceeded returning would be necessary. The limits may be any amount that is established for any particular shop or class of locomotives.

Where the micrometers shown in Fig. 1 are used, the gage points *C*, *D*, *E* or *F* located on the frame, are set for the proper diameter. The micrometer is placed over the journal and the micrometer screw adjusted for the largest diameter of the journal and the size read. The micrometer is then rolled around the journal until the smallest diameter is found,

when a second reading is made. This is repeated for both ends of each journal. If readings are within the prescribed limits the journal is passed, if not, the journal is returned. This offers a quick and accurate method of determining if the variation due to wear is within the limits. If a journal is within the limits, the size at its largest diameter is recorded on a special blank for that purpose. Where the journals are returned, their sizes are measured after returning, for the double purpose of checking the accuracy of the turning operation, and recording on the blanks.

This method of measuring has the advantage of showing if the journals are within the prescribed limits as the axle comes to the shop for repairs, or after the turning operation. In other words, the inspector can settle the question of returning or passing with accuracy, which is much more reliable than by the sense of feel with machinist's calipers. In addition it removes the personal equation, which an inspector generally welcomes.

The distance between wheel hub faces are readily measured with inside tubular micrometers such as are made for the trade by one of the leading tool making concerns. This distance is also recorded on the blank. For this measurement it is customary to obtain inside micrometer calipers differing by one inch steps.

Measuring Bore of Driver Boxes

To measure the bore of a driver box shell, or crown brass, with machinist's calipers, or any two-point caliper, presents difficulties owing to the shells in many cases being less than a half-circle. In the September, 1920, issue of the *Railway Mechanical Engineer*, a three-pronged micrometer gage was described and illustrated and is here again shown in Fig. 2. Quoting from that issue: "The three prongs *H*, *H*, and *H*¹, are forced outwards by the descent of the taper plunger *G*, that in turn is controlled by the micrometer head *E*, the diameter being indicated by the readings on the micrometer dial similar to the method of reading instruments of this nature." It will be noted that the three points cover a range of 140 deg. Therefore, a shallow shell may be measured. This caliper gage can readily be made in a railway tool room, the principal requirements being close fitting and the proper angle on the plunger *G*. For the purpose of testing, cast iron or boiler steel ring gages are made to sizes varying by exactly one inch. When testing the accuracy of the finished product, the gage is made correct at the smallest and largest range. That is, a gage having a range from seven to eight inches would at time of manufacture be made so the micrometer head will read zero in the seven-inch ring and one inch larger in the eight-inch ring gage. These ring gages are also used for master gages for the purpose of checking the three pronged gage in everyday practice.

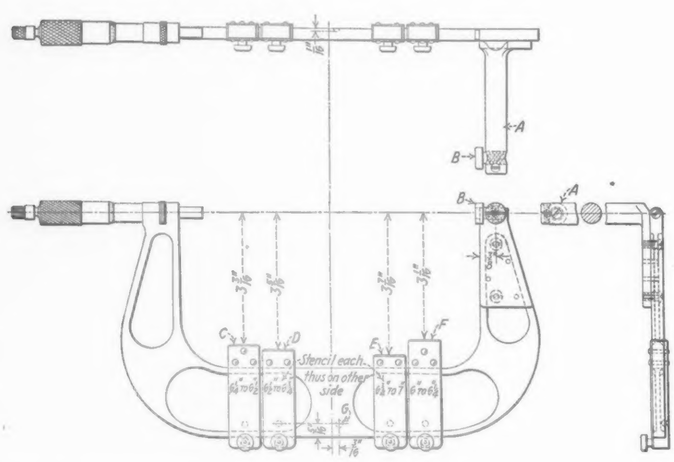


Fig. 1—Micrometer Caliper with Special Attachment for Measuring Wheel Seats on Axles

Setting Boring Mill Tools

When setting the cutting tools in a boring mill equipped with micrometer dials or where an adjustable boring bar having a micrometer dial is used, it is the practice to set the tools approximately correct, make a trial bore approximately one inch deep on a driver box, and measure the bore with the micrometer gage shown in Fig. 2. The micrometer dial on the machine or on the boring bars is then set to agree with the gage reading, or the difference between the dial reading and the actual bore is noted. If the machine is equipped with separate roughing and finishing cutters, the dials are set for each. After properly setting the dials on the mill or boring bars, the varying diameters of the boxes encountered in every day practices are readily bored by simply turning the saddle screw or boring bar screw so that the dials indicate the correct size and following up the wear of cutters by readjustment of the dials.

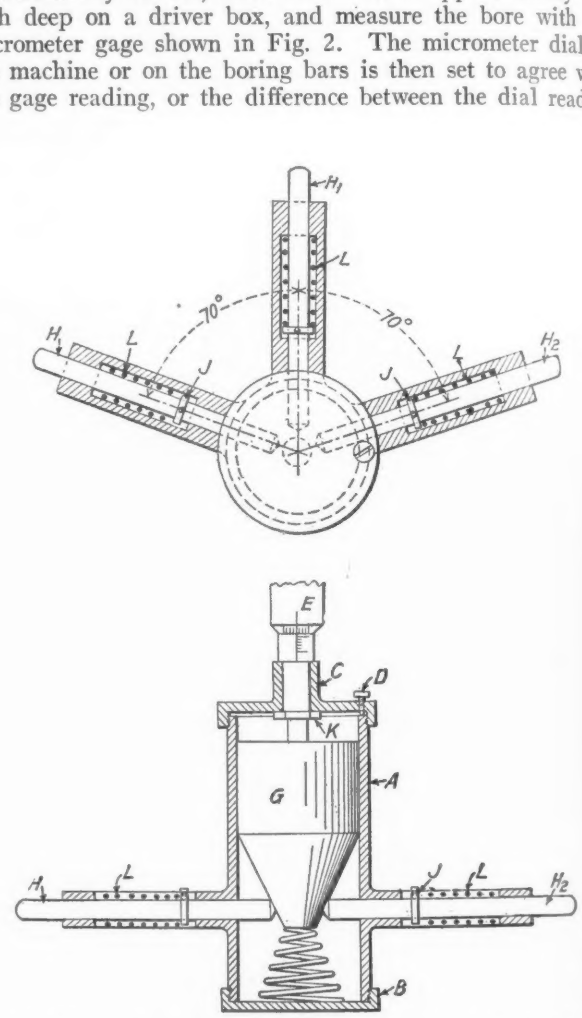


Fig. 2—Three Pronged Micrometer for Measuring Crown Brasses

As previously mentioned, the sizes of the journals are recorded on a blank. The boring mill operator rough bores the shells about .040 in. smaller than called for on the blank and then finish bores the required amount larger than shown on the blank, or larger than the axles. After completing the boring, the diameter is measured with the micrometer gage for the purpose of checking the accuracy, which is the only measurement of the bore of the shell required. This eliminates stopping the boring mill for the purpose of taking measurements.

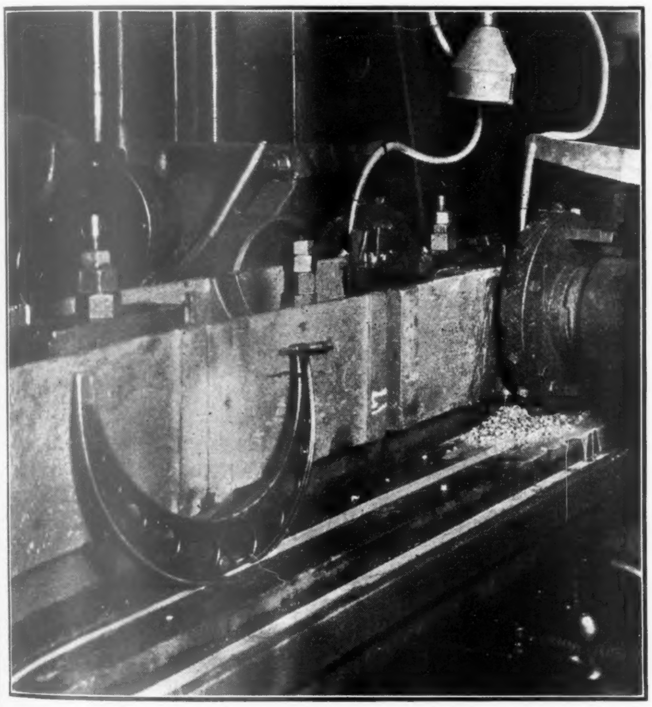
The operation of setting the tool for facing the box is as follows: The distance between the driver wheel hub faces as recorded on the blank is noted. One-half of the amount that this distance may vary from the standard is added to, or subtracted from the distance between the box side wearing sur-

face and the space on the box for shoe and wedges. If the distance as measured between the wheel hub faces is, owing to wear or refacing, .250 in. greater than standard, .125 in. is added when facing the box. Generally when setting the facing tool the distance from the shoe and wedge space to the point of the tool is measured with a rule. If greater accuracy is called for an inside micrometer is used.

Actual experience has shown that where micrometer calipers are used and with a modern boring mill arranged for box work, boxes to the different diameters encountered in repair work are bored, faced, filleted, sharp corners removed from ends of shell and cellar bored about 1/16 in. larger than the axle in 15 minutes from floor to floor. Or on an all day run of eight hours, 24 boxes are readily bored, faced, etc. This large output is made possible owing to the fact that the machine work is delayed less than ½ minute for each box for the purpose of taking measurements.

Fitting Bushings Properly

When replacing piston valve bushings, it is quite essential that the bushings shall properly fit the bores of the cylinders. If the bushing is too large it is difficult to force it into place, and if too small, steam leaks may result. One of the unfortunate conditions encountered in repair work in connection



Micrometer Caliper Used When Repairing Driving Box Cellars

with fitting bushings, is that the bore of cylinders may not be a true circle. This irregularity may result from the springing of the cylinder when removing the clamps at the time of boring; the effects of heat warping the casting, etc. In order to fit new cylinder bushings properly the out of round condition of the cylinders should be taken into consideration and the bushing turned to meet the average conditions. In order to overcome this condition the cylinder bore and bushings should be measured for average diameters.

The bore of the cylinders for the piston valve bushing can best be measured with tubular inside micrometer calipers. The practice is first to determine the largest diameter, make a memorandum of it, and then measure to find the smallest diameter, and also record it. These two sizes are added and divided by two, which gives the mean diameter. That is, if the largest diameter is 15.860 in. and smallest 15.850 in., the two added together and divided by two will be 15.855 in.

Measuring cylinders in this manner has the advantage of obtaining accurately the average mean diameter and is a quicker method than measuring with machinist's calipers. In a large shop where locomotives are distant from the place where bushings are turned, one inspector can measure all the cylinders and give the sizes to the lathe hand who turns bushings, thus avoiding any delay to the lathe hand. In the smaller shops, the lathe hand measures several cylinders at one trip.

The commercial outside micrometers have been found very satisfactory for making measurements when turning the outside of piston valve bushings. The practice is to turn the bushings a certain number of thousandths of an inch larger than the mean diameter of the cylinder bore to allow for the desired amount of force fit. The amount larger than the bore will vary according to shop practices, which should be about .005 in. larger than the bore, the limits either way not exceeding .002 in. This may appear to be a close limit for cast iron bushings 12 in. to 18 in. in diameter. However, where micrometers are used, the workmen acquire the ability of measuring and turning, and thus readily meet these limits.

Considering the fact that these bushings must be steam tight in the cylinders, that an improper fitting bushing often necessitates its withdrawal when partly applied, and that measuring the cylinders saves time, the micrometers are a good proposition for this work.

Inside micrometers are also useful for measuring the amount of wear of the inside diameter of piston valve bushings. Where limits have been set governing this wear, measurements with these instruments at once show if the limits have been exceeded, and as a result the inspector can mark the bushings ready for reboring or renewal.

Cylinder and Piston Heads

When a locomotive is stripped and the surface of the bore of the cylinder is found to be in a good condition, the question of reboring or passing should naturally be governed by the amount of wear or difference in the diameter of the bore. Good practice also indicates that there should be a limit governing the bore where a locomotive is undergoing heavy repairs. It is a question if the cylinder should be rebored where the difference in the diameter of any two measurements of a single cylinder does not vary more than .032 in. A greater allowance should naturally be made for running repairs.

When cylinders are rebored they at times are found to be larger at one end than the other, which may result from defective boring bars, wear of cutting tools and other causes. Good practice also indicates that limits should be set to govern this condition. It is a question if this limit should be less than .010 in. as the packing rings should take up this amount without excessive wear in the grooves of the piston heads. Cylinders, where the bore has been found true, must be measured in order to turn the piston heads and packing rings.

All of the above mentioned measurements are quickly and accurately made with tubular inside micrometers. It is the practice for the inspector to measure the cylinders which have not been rebored at different locations and angles, and from the result of these measurements to mark the cylinders for reboring or passing. The micrometers at once indicate if the required limits prevail, fully as well as would be the case if it were possible to make use of snap limit gages.

The amount a piston head should be smaller than the cylinder bore has not been clearly defined. Practice appears to indicate that for cylinders up to 30 in. diameter the piston should be about .032 in. less in diameter, subject to a tolerance of plus or minus .010 in. The decimal meas-

urements of piston heads assembled on the rods are easily made with the sliding or adjustable micrometer. From the inspector's list of cylinder diameters, the amount the piston should be smaller than the cylinder is subtracted and a list showing the required diameter for each piston head with the locomotive number is handed to the lathe hand, who turns the piston heads to the diameters called for.

Advantages

It has been the practice when measuring the diameter of the cylinders for piston valve bushings for the lathe hand to go to the locomotive where he either sets machinist's calipers for each bore or makes use of adjustable pin gages. Where the bore is out of round an estimated allowance is made for this condition. Cylinder bore measurements are made by a number of methods, such as setting a separate pair of machinist's calipers for each cylinder and then measuring with another pair of calipers and transferring this measurement to a rule and recording the size on a memorandum, using adjustable pin gages, etc. All of these generally make it necessary for the lathe hand to leave his station for each cylinder for the purpose of measuring which results in considerable delay to the lathe. Where more than one measurement is made on a trip, several gages must be carried along.

By the use of micrometers an inspector measures all cylinder, piston valve and bushing bores before and after repairs, indicates the amount of repairs and makes the necessary memorandum of sizes for the use of the lathe hands. As a result the lathe hands working on piston heads and piston valve bushings do not leave their machines. As these tubular inside micrometers are light and small in diameter, the inspector readily carries the full complement necessary to meet all requirements for different diameters of cylinders and piston valves.

The inspector may at first glance, in some of the medium sized shops, look like an added man. The term inspector does not necessarily imply that he shall be confined entirely to cylinder work. Where the cylinder work is not sufficient he can also measure axles, crank pins, or any other work requiring accurate measurements.

A question may be raised as to the advisability of one person measuring the cylinders and a second measuring the turned piston valve bushings and piston heads from a memorandum of sizes made by the first person, because of the divided responsibility. In actual practice, it is found that errors rarely occur, partly, owing to the fact that the micrometers measure exact sizes and also the memorandums of sizes become a record, where, in the event of errors, it is referred to and the blame placed on the lathe hand or the inspector responsible. One of the greatest advantages results in the toning up effect on the men. Where a size in decimals is given to the lathe hand he, as a general rule, is anxious to finish his part to the sizes called for with the least amount of error.

Valve and Piston Rods

For repair work, the actual diameter of a piston or valve rod is of minor importance, providing they are not above the maximum or below the minimum allowable diameters. It may look like extravagance to recommend micrometers for this purpose. It is, however, very important that the section of the rod which passes through the metallic packing shall be of one diameter for the entire distance owing to the fact that the metallic packing, now generally used, will not accommodate itself during each stroke to the different diameters where they exist in a single rod. If a nominal four-inch rod has been worn or refinished to 3.896 in. this diameter should prevail for the entire packing ring surface.

Owing to the weight, length and the possibility of the springing of these rods during the time of repairs, it is somewhat difficult and expensive to machine to one actual diameter from end to end even on the most modern grinding machine. Practice and shop output would indicate that a tolerance should be set to govern the difference in diameters of a single rod. It is believed, however, that when balancing the wear of metallic packing and the possible steam leaks against the added cost of finishing, this tolerance should not exceed .003 in. That is, for the undersized rod the diameter at one end could be 3.896 in. and the other end 3.893 in. without serious detriment. About the only practical way of measuring this tolerance is with outside micrometers, and as three or four sets will answer for practically all piston and valve rods, their use is to be recommended.

One advantage of micrometers as compared with machinist's calipers is the ability to inspect, measure and read the

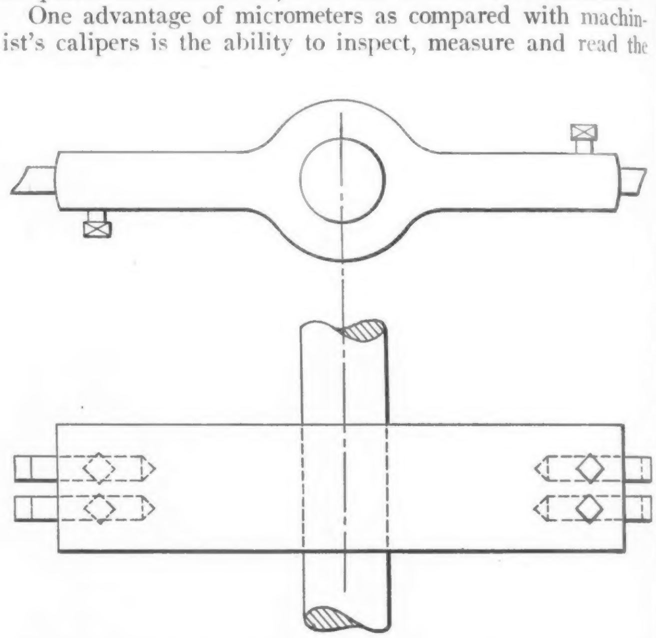


Fig. 3—Non-Adjustable Boring Bar Head for Truing Up Piston Valve Bushings

actual difference in diameters. The greatest advantage will be derived because the machine operator, when making use of these instruments, is in a position to measure the actual difference in diameter, and he will gradually work up to a higher standard which will eventually result in finishing these parts well within the tolerance mentioned.

Piston Valve Parts

There are a number of designs of piston valves and parts and, therefore, no general method can be advanced for measuring all of the parts that go to make up the completed article. When repairing piston valves, the parts on most designs can to a large extent be brought back to certain standards and limits which in most cases will reduce the time and the cost of machine repairs. As an illustration, it is entirely practical to establish step sizes governing the bore of piston valve bushings and correspondingly the diameter of the packing rings. They, as well as bull rings and spools on most designs of valves, can at times of repairs be brought back either to the original sizes or to limits varying from the required sizes an amount that will not interfere with the proper working of the valve.

In a number of shops it is the practice after applying piston valve bushings to bore to standard sizes such as 12 in. and 14 in. When repairs make it necessary to rebore, it is the general practice to bore 1/8 in. larger than the standard size. Packing rings are kept in stock which are cut to a suitable diameter for any of the standard sizes of bushings. The thickness of the rings is made correct for a running fit in the piston valve grooves.

Good practice indicates that piston rings should be from

.002 in. to .004 in. less in thickness than the piston grooves. It is evident that where the rings are machined to the proper diameter they will fit correctly bored bushings without waiting for the wearing in process. With proper measuring instruments and boring bar heads the diameter of packing rings and the bore of piston valve bushings can readily be made entirely interchangeable.

Boring Bar Heads

It is the practice in some shops to make use of the non-adjustable boring bar heads when boring piston valve bushing while in place in the valve chamber. A separate head is used for each step size of bushing, which multiplies the number required. However, their cost is comparatively low,

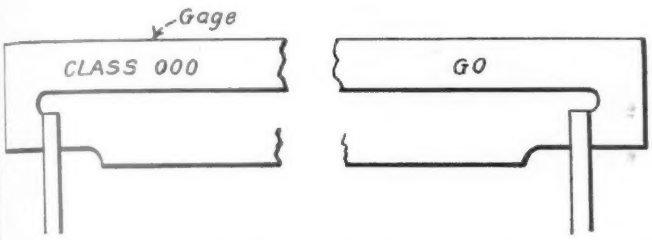


Fig. 4—Solid Gage Used to Measure the Limits When Making New or Repairing Old Piston Valve Spools

and considering the saving in time when boring the bushings and also the saving as a result of interchangeability, these heads are a good investment.

These heads, which are generally used on the regular commercial cylinder boring bars, are made in a number of forms, one of which is shown in Fig. 3, which shows two sets of two cutters set 180 deg. apart. The cutters are held by set screws, to guard against accidentally shifting. Liners are placed at the bottom of the cutter sockets in which the cutters are held. As the cutters are sharpened, additional liners are made use of to compensate for the decreased length of the tools. Previous to grinding, it is the practice to set the cutters outwards a sufficient amount to allow for the grinding. The head is then placed on an arbor and the cutting tools are ground on a cylindrical grinding machine similar to sharpening milling cutters. The measurement over the second or finishing cutters is to the exact size required, such as 12 in. and 14 in. The leading or roughing cutters are ground about .010 in. smaller, such as 11.990 in. and 13.990 in. The size over the cutters is measured with micrometers.

The advantages of non-adjustable cutter heads when compared with adjustable heads where the tools must be set for each size, are that the cutters are sharpened in tool rooms where the men are accustomed to close work; time is saved in the erecting shops and engine houses by eliminating tool setting and, principally, accuracy of the bore is insured, which makes interchangeability possible. While measuring devices in connection with the boring heads are only secondary, the accuracy of grinding is very essential in order to obtain the desired results.

When blanking out piston valve packing rings, in a number of shops it is the custom to rough turn the outside surfaces. The bore and width, however, are made to the required dimensions. After completing the blanking out operations, the rings are cut, compressed so the openings are reduced to about 1/16 in., and while in the state of compression, are clamped on their sides in a special arbor. The rings are then turned or ground to the required diameter. The measurements of the diameter are made with outside micrometers in order to insure accurate workmanship and interchangeability. The width, at the time of machining, is measured to good advantage with micrometers. The latter limits, as mentioned above, are between .002 in. and .004 in. less than the width of the groove of the piston valve.

Gages for Piston Valve Spools

Piston valve spools generally wear on the end surfaces which rest against the packing rings. This makes it necessary to refinish these surfaces which reduces the distance between the packing rings and, sooner or later, a point is reached where the valve will not function properly owing to this reduction. When making repairs, the spools, when only slightly worn, are refaced, or, if too short, the original length is restored by autogenous welding or by welding sheet metal rings to the end surfaces, after which they are faced to the original length. In order to govern the kind of repairs required for each valve, limit gages have been used to good advantage.

The amount of limit allowable has not been clearly defined and will naturally vary with different classes of power and individual opinion. It is, however, a question if a valve spool 1/32 in. less in length than the standard will not affect the operation of the locomotive, and this is mentioned as a limit to govern the amount a spool can be faced at the time of making repairs. When making new spools, or where spools are built up on their ends, without calling for too close and expensive workmanship, they are readily faced to a limit not exceeding .002 in. plus or minus. In other words, a new spool having a nominal length of 24 in. can be between 24.002 in. and 23.998 in. in length, and when refaced is between 24.002 in. and 23.968 in. long. To govern these limits solid gages are often used. Fig. 4 shows a form suitable for this purpose. Three are required for each class of spool which are the maximum and minimum for new and built up spools, and the minimum for repaired spools. This often makes it necessary to provide a number of gages. However, when making new spools or repairing spools, the workman, having the limit gages as a guide, will eventually produce a more uniform distance between the packing rings and correspondingly better working valves. As a substitute for the numerous gages mentioned above the sliding micrometer can be used to good

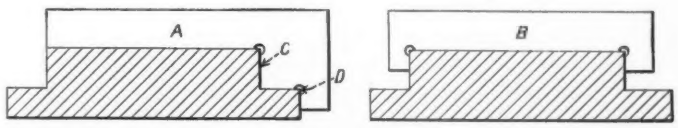


Fig. 5—Gage for Measuring Packing Ring Space in Piston Valve Bull Rings

advantage. When using this instrument printed instruction should be placed in the hands of the workmen

Bull Rings

When making or repairing bull rings it is quite important that the packing ring space shown in Fig. 5 at *C* and *D* shall be correct in order that the rings may move freely and without an excessive amount of side play. The solid gages shown in Fig. 5 have proven very satisfactory for this purpose. The distance from surfaces *C* to *D* on the gage agree exactly with the width of the packing rings. For ½-in. packing this dimension is exactly that amount. In operation the gage is placed on the outside of the bull ring. When in this position errors as small as .001 in. are readily detected. The gage shown at *B* is for measuring the overall width of bull rings. Two of these gages constitute a set, one for the new bull rings and a second having an opening agreeing with the allowable decreased width such as used for repaired parts.

Advantages of Gages and Measuring Devices

By providing the workmen with suitable gages it has been found that they will readily machine the various parts of

the piston valves to the limits called for without consuming an increased amount of time, and, as the parts are all interchangeable, the valves are assembled without individual fitting with the corresponding reduction in time. By boring piston valve bushings to step sizes, the valves become interchangeable with the bushings, and as a result the valves may be repaired in quantities and kept in stock. One of the advantages well worth mentioning is that of allowing the correct amount of side play for the packing rings when assembled in the valves which is readily obtained by the interchangeable manufacture or repair of parts.

Cleaning Out Air Pumps

AN effective device for the periodical lying out of air pumps, used at the Albuquerque enginehouse of the Atchison, Topeka & Santa Fe, is shown in Figs. 1 and 2. In order to maintain these air pumps in efficient operation it has been found necessary to clean the air cylinders thoroughly once in three months. This cuts the old oil and lubricant from the air cylinder walls and to a certain extent at least removes the carbon which has formed in air ports and passages. The benefit of this cleaning operation was found to be sufficient to justify removing the air pumps

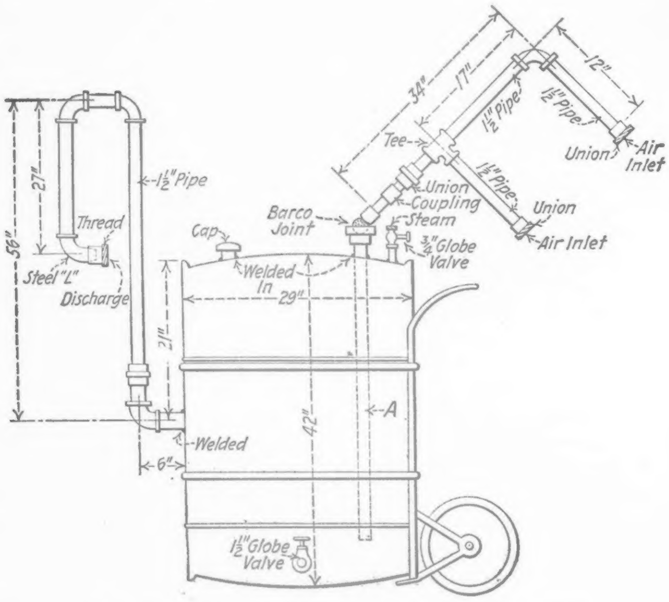


Fig. 1—Apparatus for Cleaning Out Air Pumps

at three months' intervals but by means of the apparatus illustrated in this article, the cleaning operation can now be performed just as well without removing the pump from the locomotive.

Referring to Fig. 1, the construction of this simple apparatus may be described as follows: An oil barrel 29 in. in diameter by 42 in. long is mounted on a pair of truck wheels with handles for convenient movement about the enginehouse. Pipe *A* extending nearly to the bottom of the barrel, is welded into the top head to make an air-tight joint and arranged with suitable pipe connections and a Barco joint, enabling the pipe to be connected to both inlets of the air pump. The small ¾-in. globe valve at the right of pipe *A* is for the admission of steam to heat the water and lye solution. The air pump discharge is piped to the middle of the barrel as shown. A cap for filling is welded in the top head of the barrel and a 1½-in. globe valve for cleaning out is provided at the bottom. The appearance of this apparatus after being connected up ready for operation is shown in Fig. 2.

In operation, the barrel is filled perhaps two-thirds full of a solution of lye and water which is heated and kept hot by steam from the blower line through the ¾-in. globe valve. The air compressor being started, this cleaning solution is drawn through the air inlets to the low-pressure cylinder. It passes to the high-pressure cylinders and is discharged back into the barrel where sediment and foreign matter settle to the bottom. A comparatively short operation of the pump

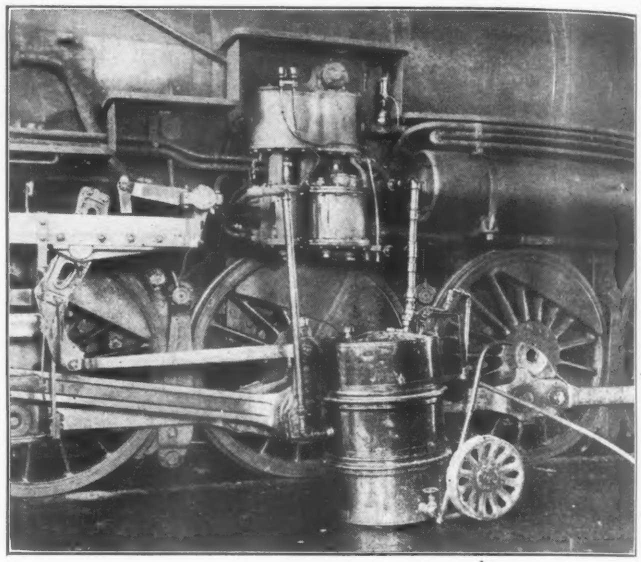


Fig. 2—View of the Clean-Out Tank in Operation

suffices to clean the air cylinders thoroughly, after which a supply of good, clean lubricant will again place the air pump in condition for efficient operation with greatly increased life of piston packing rings, and cylinder bushings.

Pitting and Grooving in Boilers*

IN some districts in the United States and Canada, it has been found that corrosion, as evidenced in the pitting of flues, and the grooving of fireboxes, is a serious embarrassment in the maintenance of locomotive boilers.

The writer has had some experience of a general nature in these matters and has taken advantage of the opportunity of consulting with those who have had much to do with them.

Boiler metal corrosion is merely oxidation of the iron or its solution in water. Pure water will dissolve iron to some extent. That is the reason that absolutely pure water is not best boiler water. The presence of a little lime, in otherwise pure water, is frequently found to be a safeguard against this action and is, therefore, desirable.

The fact that this corrosion is evidenced in pits, or grooves, is due to lack of homogeneity in the metal of the parts affected. In other words, the boiler metal is not just alike in its qualities throughout its area. No commercially used iron can be pure, and steel is adulterated iron. If the other chemical elements used are not evenly distributed, we have metal of different tendencies at different points.

If absolute homogeneity were possible and were secured there would still be corrosion, under some conditions, but not in the form of pits or grooves and not for the three causes which are given below.

Causes

It is found that pitting and grooving take place in connection with the use in boilers of three distinct general classes of water evaporated, as follows: 1, pure water; 2, water

*Abstract of a report presented at the convention of the Master Boiler Makers' Association, held at Chicago, May 20 to May 23, 1924.

containing acids; 3, water containing alkaline salts, such as sodium sulphate, in excessive concentration.

Pure Water—It is a surprise to many to learn that absolutely pure water is not a good boiler water. Iron dissolves to some extent in pure water, and more rapidly in rain water, which is usually considered pure water. This is a fallacy, as rain picks up all sorts of impurities on the way down. Natural waters which contain small amounts of lime, as an impurity, are the best boiler waters.

Water Containing Acids—Mine waters usually contain sulphuric acid and since such water has to be pumped to clear the mines, it is frequently made use of for boiler supplies. Salt water frequently shows up hydrochloric acid (produced by reaction). This is met with by railroads near seashores and sometimes inland. The effect of either of these acids is to produce more or less rapid corrosion of the metal of the boiler, by acid solution.

Water Containing Alkaline Salts in Concentration—Where waters are very hard in sulphate scale and where a soda ash treatment is used to reduce this scale, sodium sulphate is a product of the reaction. This salt remains in solution in the boilers and concentrates as steam is evaporated off. This concentration seems to furnish the electrolyte for galvanic action, which means decomposition by stray electric currents. These currents travel between points of different electric potential always in the same direction and they carry off the metal with them.

Prevention

There being three general reasons for corrosion, as given above, it will be necessary, in attempting to prevent the condition, to first decide upon, and classify, the cause.

Any water which causes corrosion should be abandoned, if possible, and substituted with better water supplies. That is always the first consideration in attempting to improve boiler conditions. If it is impossible to get waters which are satisfactory in their natural state, then steps must be taken to change the nature of the waters which it is necessary to use, and which are troublesome. It would be best, however, to again call attention, at this point, to the secondary cause for pitting and grooving, dependent upon a general corrosive condition.

If boiler metal were entirely homogeneous; that is, if it were possible to have flues, for instance, with the metal exactly alike throughout their area, corrosion would not take the form of pitting, because if the reason for corrosion is acid action, it would be uniform throughout, and the flues would slowly dissolve away, in uniform manner. If, however, the cause of the corrosion is galvanic action, electrical couples would not be formed at different spots and again there would be no pitting, and in fact, in all cases, there would be very little corrosion of any kind. Therefore, under the subject of prevention, we must first consider metal quality.

It is generally believed that charcoal iron is more homogeneous than steel and that iron tubes are, therefore, more resistant to corrosion than are drawn steel tubes. Whether or not this is true, the writer is not prepared to say. It would seem as if steel could be made as homogeneous as iron and it is evident that if it were so made, it would be just as good.

Generally speaking, it is theoretically easy to draw conclusions as to the cure for corrosion in that the causes are so simple. The remedies suggest themselves when the causes are determined. In practice the matter is just a bit more difficult to handle in some cases. Acid action is stopped by alkaline neutralization. Galvanic action may be reduced by changes in the method of treatment, to prevent the concentration of sodium salts in the boiler, or by adding chemicals which will change its nature. Pitting and grooving can be reduced by obtaining more homogeneous metal.

Relative to the treatment of water, the railroad with which I am connected (C. I. & L.) has used polarized mercury chemicals for several years, and it is believed that this is one of the reasons why we are so little troubled with pitting and corrosion. In mine waters which we use in southern Indiana, acid action is prevented by the alkaline agents in this treatment. In other districts, notably the territory surrounding Lafayette, Indiana, at which point we are forced to use more and harder water than at any other single point on the line, the soda ash treatment was used several years ago, and abandoned on account of the necessity for using a very heavy treatment, to reduce all of the scale forming impurities. This caused foaming and probably was the cause of pitting, in that we had that condition, to some extent, in our boilers, indicating galvanic action.

The boilers operating in this district are using the mercury chemical treatment of somewhat different formula, from that used in the mine region. The mechanical action of the mercury assists the chemical action, so that the chemical treatment is never heavy enough to produce any great concentration of sodium salts in the boilers.

Moreover, it is noted that where this material is used there is a surface coating of a black glassy nature on the heating surfaces. This, I am advised, is a mercuric oxide of iron and is a good conductor of electricity. It seems logical to believe, therefore, that any lack of homogeneity in the iron is, to some degree, at least, offset by this surface coating which furnishes a pathway for the stray currents generated in the boiler; in other words, it makes a homogeneous surface or non-homogeneous metal, and that is all that is necessary under these conditions.

We are now getting very good flue mileages averaging around 75,000 miles for all classes of engines, and fireboxes are giving us proportionately good service. This is in what we are told is the hardest water district in the country.

This report was prepared by a committee composed of Lewis Nicholas, chairman; H. V. West and F. J. Howe.

Discussion

It was generally agreed during the discussion that pitting and grooving was not confined to one place. The degree and extent of this deterioration varied according to the chemical content of the water used in the boiler. It was thought that the problem was one for the chemist to solve. The prevention of pitting could be accomplished through the use of the proper chemicals determined by a thorough chemical analysis of the boiler feed water.

Locomotives in the Shops of Messrs Sir W. G. Armstrong, Whitworth & Co., Ltd., Manchester, England, Awaiting Shipment to India.

Time Element Vital in Modern Blacksmith Shop

Master Blacksmiths in Convention at Chicago Discuss This and Other Important Phases of Their Work

ONE of the points brought out by the railroad master blacksmiths in convention last month at Chicago was the pressure under which they now work in meeting the time limits set on blacksmith work by short locomotive and car schedules. Corners must be cut and a full complement of modern shop machinery used in conjunction with all the modern welding processes and carefully trained operators in order to prevent cars and locomotives from being delayed in repair shops, waiting for blacksmith work.

While the modern blacksmith foreman has been largely relieved of the responsibility of frame making, his problem in repairing frames is greater now than ever. His duties in manufacturing tools and formers, dies and machine forgings have also increased. The program of this year's convention dealing with all of these and other subjects was highly instructive. It is to be regretted that only about 90 members of the association attended and benefitted by the reading of the papers and the subsequent discussion. Some of the papers presented at this convention will be abstracted in this and later issues of the *Railway Mechanical Engineer*.

The International Railroad Master Blacksmiths' Association decided to hold its 1925 convention in Cleveland. The following officers were elected for next year: President, J. J. Egan, N. Y., N. H. & H., New Haven, Conn.; first vice-president, H. W. Loughridge, P. & L. E., McKee's Rocks, Pa.; second vice-president, C. H. Nutter, B. & M., North Billerica, Mass.; secretary, W. J. Mayer, Michigan Central, Detroit, Mich.

Frame Making and Repairing

By J. H. Chancy

Blacksmith Foreman, Georgia Railroad, Augusta, Ga.

The steel foundries have relieved the smith foreman of what was in former years a great task, namely, that of frame making. Today, the smith foreman has as one of his major problems the task of repairing locomotive frames. Moreover, as blacksmith foremen we are required to do this work in a much shorter time than in the past when repairs were made in the smith shop. Considering the time allowed to get a locomotive back in service with proper repairs made we frequently find ourselves confronted with problems in running repairs that are indeed trying. In coping with these problems we need all the modern welding processes, one of which is usually best suited to the particular conditions accompanying each welding job.

On the Georgia Railroad we use the Thermit, oxyacetylene and electric processes. We find all of them successful when experienced operators are used in performing the work. If I were called upon to name the best process I would prefer naming the best operator.

We may have all overlooked to a certain extent the importance of properly trained operators for making welds with these new processes. Perhaps we are not to be too severely criticized for this oversight because we ourselves were inexperienced. In the old way of taking care of frame repairs the foreman ran no risk whatever in assigning it to his most capable and experienced men and in seeing that ample help was available. Many times he would take part himself when necessary. In those days success was certain but the same is true of the new processes of welding and I believe with the proper interest used in training our operators we are sure to realize our fullest expectations.

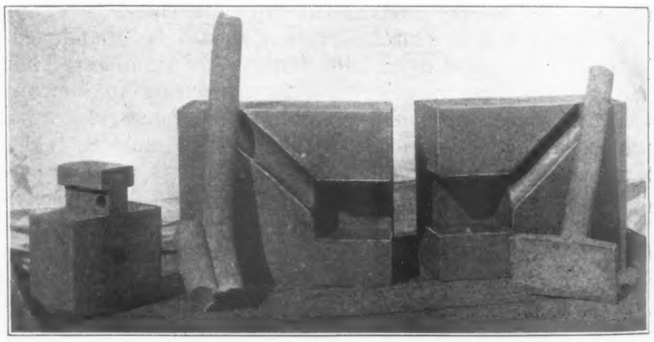
Appreciation should be accorded to the instructors in these new welding processes who from time to time have given us the benefit of their experience and faithful efforts. Not only have they helped instruct our men but in many cases they have given their own services and performed particularly difficult welding jobs themselves.

Carbon and High Speed Steel

By G. W. Kelly

Blacksmith Foreman, Central Railroad of New Jersey, Elizabethport, N. J.

The subject of carbon and high speed steel is such a broad one that this paper must be limited to the general application of these steels to shop use. Tool steel is one of the most important materials which come under our supervision. The writer will not attempt to compare the usefulness of carbon and high speed steel. The fact that a high degree of skill is required to get the best results from carbon steel has caused it to be superseded by high speed steel for many uses. For some kinds of work, however, carbon steel is equal and even superior to any high speed steel, provided it is dressed



Dies Used in Forging Smoke Arch Braces

properly and receives the proper heat treatment. For high speed work, however (and more and more of car and locomotive work has moved into this class), high speed steel is required to hold the temper under the heat conditions attending high speed operations.

Each year steel makers discover new alloy steels which are welcome in the blacksmith shop. This may be due to keen competition among the steel manufacturers but the result is a non-deforming steel which gives a uniform product by oil or air hardening. Such a product is particularly satisfactory in making reamers, taps, punches, dies, hard die blocks for forging machines and drop hammers and all hot working die blocks.

It is the writer's experience that, wherever possible, steel should be ordered cut to the proper lengths and annealed. In this way it is possible to route steel from the receiving department into the toolroom. In any case, the less forging steel received in the shop, the better. Steel may be forged at a higher heat than a hardening heat but it must then be annealed. The hardening and tempering thereafter are heat treating operations and in themselves form a broad subject.

The steel makers know their steel best, and give explicit instructions for the handling of their products. A study of their literature by careful workmen usually brings satisfactory results. To get uniformity of product in finished tools

we must have uniformity of steel and uniformity of operation throughout. To insure the same stock, great care should be exercised in marking each end of the bar at the steel mill. Labels are often made illegible in shipping. Each bar should be marked on each end.

Smoke Box Brace Dies

One of the odd shaped forgings on locomotives which occasionally break and require renewal is the smoke box brace. The dies illustrated were developed at the Elizabethport shops for making this forging, the operation being plainly shown in the illustration. Two and one-half inch round iron is used. After the iron is cut and bent over as illustrated, a soft heat is taken and the smoke box brace formed in one stroke of the machine. A five-inch Ajax forging machine is used for this operation.

Frame Sections Made of Scrap Axles

By W. F. Keller
Blacksmith Foreman, Michigan Central, Jackson, Mich.

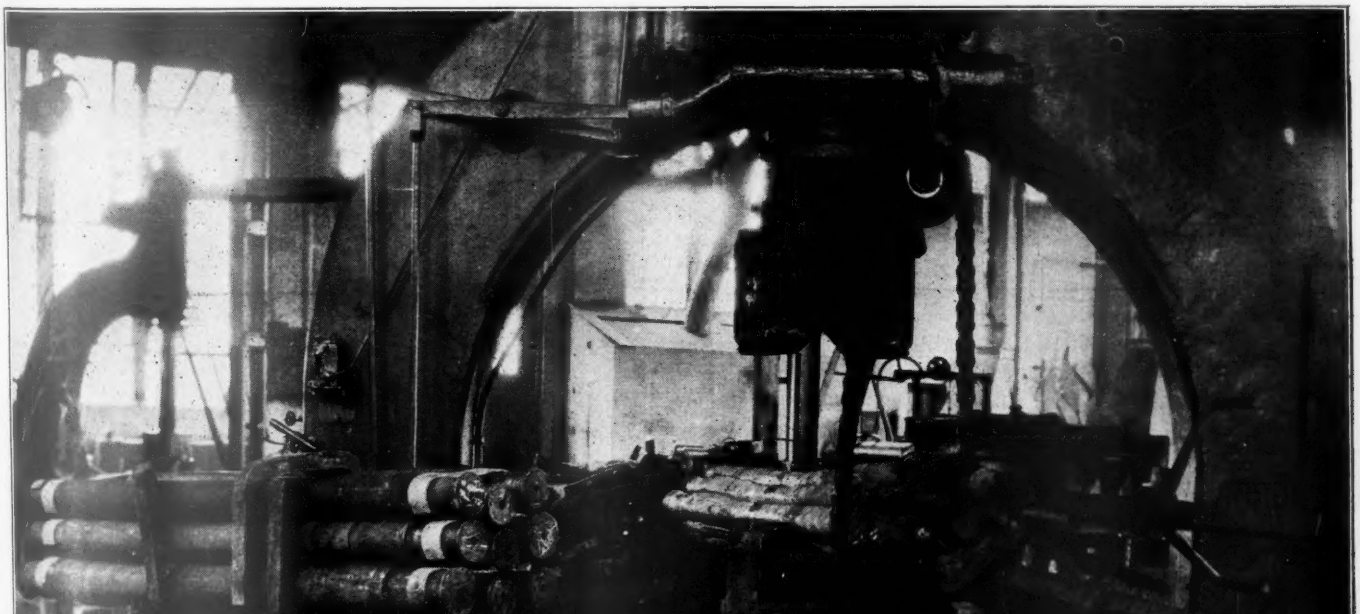
Frame repairing on locomotives such as are going through railroad shops today is interesting work to all concerned due to the size of the frame and the necessary sections to be made and applied with the use of autogenous welding. The great feature in this connection is the cost of securing the necessary material for these sections, and the foreman in charge can use only the resources at hand. He must either buy bloom iron, or shingle the scrap and then slab it into billets large enough to make the parts wanted.

In the selection of this scrap we find that iron axles, 4¼ in. by 8 in., piled three wide and three high in their round state and welded into a billet as illustrated, can be drawn out into 12 in. square billets of good iron at a much smaller cost and in one-half the time required in getting the same material by the shingling process.

The axles are piled on horses inside of two yokes which keep them in shape until the straps of light iron are applied around the journals. This keeps them from spreading in the furnace while they are being heated. A special pair of tongs has been made for the purpose of handling the axles in and out of the furnace and under the hammer until the first end of the pile is welded. The pile is then picked up

Frame Sections Made From Axle Steel Billets

from the horses with the tongs, allowing the two yokes to remain on the horses. A third yoke, placed over the top of the pile just outside of the door while the axles are being heated, helps to keep the pile straight and square until the first end is welded. When heated properly the pile is taken out under the hammer and one end of almost half the length of the pile is welded and squared up in a pair of BV-blocks. The pile is then turned around and, with a pair of tongs that will take 12 in. square, the end to be welded is charged



Method of Handling Car Axles While Being Drawn Out Under a 4-ton Hammer to Form 12-Inch Square Billets

in the furnace, heated and welded without any further preparation.

In this operation a four-ton steam hammer and a two-door, 5-ft. by 8-ft. furnace are used. In eight hours we can weld four of these piles of axles which will give 14,400 lb. of iron in billet form of a quality very satisfactory for forging purposes.

Nine years of this practice has demonstrated that we can produce good iron very much cheaper and in less time than by any other method we have tried. Some of the frame sections made of these billets are shown in another illustration.

Autogenous Welding

By Joseph Grine

Blacksmith Foreman, New York Central, Depew, N. Y.

Autogenous welding has long since passed the experimental stage and has come to have a permanent standing in every day of business so far as the metal trades are concerned. It is no longer considered impossible to make any class of metal or mechanical repairs with the electric or acetylene welding method. The only factor that enters seriously into present day calculation is production. We no longer ask, Can it be done? But rather, How long will it take to do it? The answer to this question does not concern itself so much to the actual repair as with the preparation of the work previous to welding. For that reason this article deals more with the preparation of the work than with the actual repairing.

The main saving, it can be plainly seen, must be controlled by the amount of time and material saved in making the repairs. Thus in an earlier period it was the usual custom to remove the metal adjoining the breakage in any damaged member until the opening was approximately 45 deg. on a side or 90 deg. altogether. Today the opening is made only 60 deg. The saving in metal to be replaced can readily be seen and appreciated. Frames on locomotives that formerly took 10 to 13 hours to weld are now repaired in six to nine hours and apparently better welds are being made. They stand up longer and are neater and cleaner in every way. In the earlier days 12 in. an hour was considered fair speed for a good welder on locomotive boiler patches. Today we have operators that can easily produce 36 in. of side sheet welding without undoing the exertion. This is due to preparation rather than to the operator's skill. Side sheet seams are fitted closer and the edges are not so sharply beveled, thus reducing the space to be filled and at the same time giving a heavier welding surface to withstand the heat of the arc.

In many cases where continuous failures at any given point proved chronic, we have adopted the practice of removing a considerable area adjoining such breakage and applying a forging of the shape and size of the removed portion, welding it in on each end. This of course means double the welding at the time but as failures seldom recur after such treatment the consequent saving more than offsets the cost. There is little discussion at the present time concerning the various methods of making welds on any portion of a locomotive as most plants have established a method of their own to handle their particular class of work. Flue welding is possibly the only exception. Practically any method of flue welding as far as the preparation of the flue is concerned may be successfully accomplished by any careful operator except when water is in the boiler.

The temperature of welding metals at the time of application and of water at any time or temperature are so far apart that the hottest water has a chilling effect on the metal. Flues welded to a dry sheet will last as long as those applied with a water. Try a set. There is but one fair test to all things. Does it work? If not, all the theory of the ages proves nothing. The argument against welding a dry sheet of flues hinges on the fact that the flue sheet is heavy and the flue is light. No one seems to consider that the heating of the flue ~~feed~~ can be controlled by the operator. The amount of heat applied to a flue feed is just enough to cause it to unite with the welding metal. The highest point of the arc is concentrated on the sheet; the side radiation takes care of the feed. Our flues are dry welded and give the service that it is estimated they should, and more.

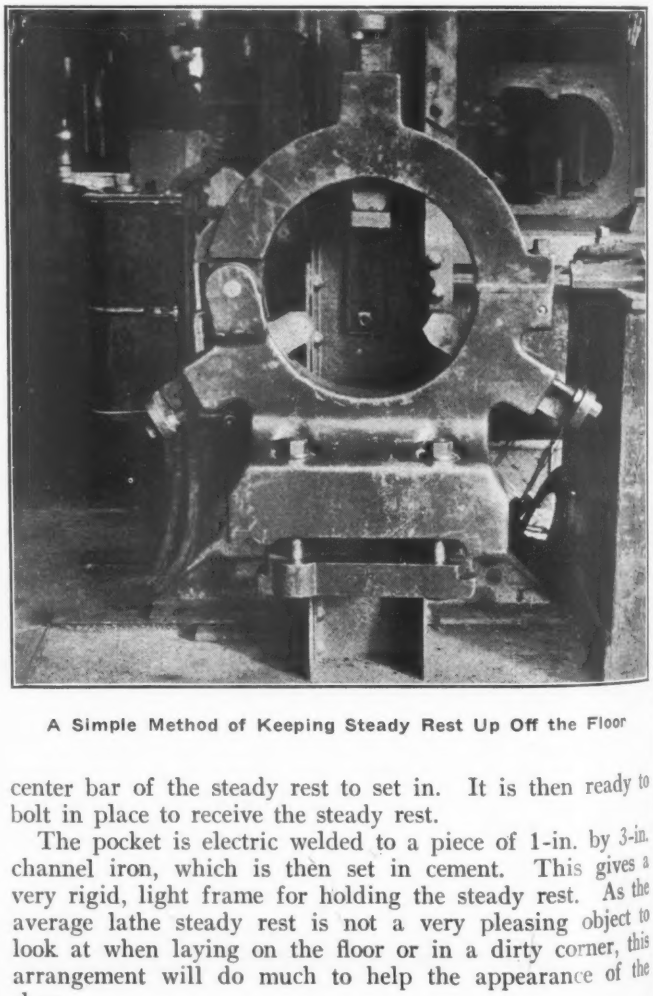
The human element is today our greatest problem—the training of men to do work as it should be done; training them to improvise to attempt things and methods for themselves, regardless of the fact that they may fail; trying to get workmen to have confidence in themselves and reduce the need of constant supervision.

Bracket and Post for Holding Lathe Steady Rest

By J. Robert Phelps

Apprentice Instructor, Santa Fe Shops, San Bernardino, Calif.

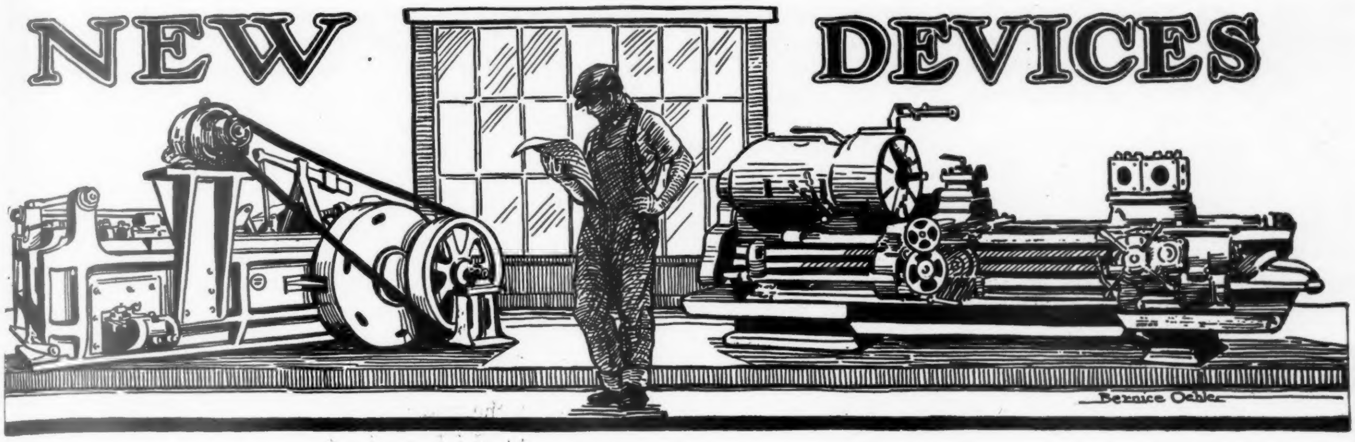
THE illustration shows a convenient and easily arranged method of keeping a lathe steady rest off the floor which permits the floor readily to be kept clean. The bracket which holds the steady rest is made by bending a piece of $\frac{7}{8}$-in. by 3-in. iron at right angles, and then electric welding on a piece of $\frac{3}{8}$-in. round iron at one end to make a pocket $1\frac{1}{4}$ in. wide by $\frac{3}{8}$ in. deep by $2\frac{3}{4}$ in. long for the top or



A Simple Method of Keeping Steady Rest Up Off the Floor

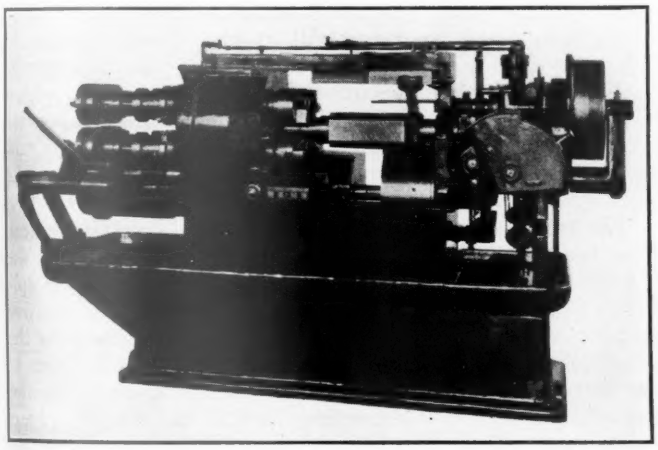
center bar of the steady rest to set in. It is then ready to bolt in place to receive the steady rest.

The pocket is electric welded to a piece of 1-in. by 3-in. channel iron, which is then set in cement. This gives a very rigid, light frame for holding the steady rest. As the average lathe steady rest is not a very pleasing object to look at when laying on the floor or in a dirty corner, this arrangement will do much to help the appearance of the shop.



Gridley Multiple Spindle Chucking Machine

TO meet the increasing demand for a production automatic machine capable of machining within precise limits numerous first and secondary operations in the shape of forgings and castings, the National Acme Company, Cleveland, Ohio, has lately added to the Gridley line a new model four-spindle machine of unique design. The basic design of the Gridley multiple spindle bar machine is followed in the chucking machine. The latter also contains the Gridley turret arrangement, consisting of a spindle carrier with the turret slide on an integral stem, as well as the Geneva stop revolving mechanism.

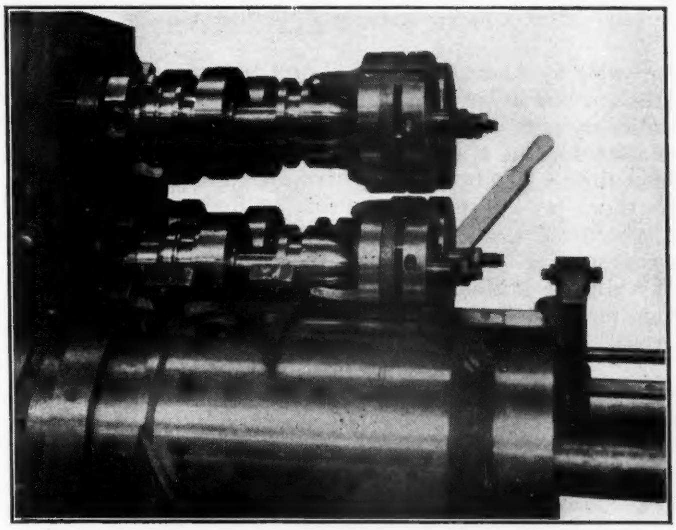


Gridley Chucking Machine with Mechanically Operated Chucks

The outstanding feature of the new machine is the chucking mechanism. This is built around the standard air chuck which has for many years been used in connection with Gridley single spindle automatics designed for chucking work. Mounted on the rear of each spindle is an air cylinder, the piston of which operates the draw bar back and forth. Behind the air cylinder is a four-arm spider casting fastened to, and revolving with, the spindle carrier. At the center of this spider is a swivel connection to which the hose from the shop air supply is coupled. From the point of this connection radial ducts pass through the four arms of the spider to the valve chambers. The valves themselves are revolving discs which in gripping position turn compressed air into the front of the cylinder to close the chucks, and in releasing position turn it to the rear of the spindle to move the piston in the opposite direction and open the chucks, at the same time releasing the pressure from the opposite end of the piston. The air enters the cylinders through swivel connections on their axes, which, in order to allow for any floating motion, are connected with the valves by heavy rubber tubing. The rotary valves are actuated by plunger racks sliding parallel to the spindle, and meshing in pinions on the valves stems. These plungers are normally kept pushed to the rear by coil springs, and while in this position hold the air pressure in the front of the cylinders, thus keeping the chucks closed.

This machine is designed so that one at a time its spindles are automatically stopped for loading, while the other three continue to run. When a spindle comes into the lower rear position, termed the fourth position, this mechanism comes into play to bring the spindle to a standstill, so that the finished work may be removed from the chuck, and a blank piece substituted.

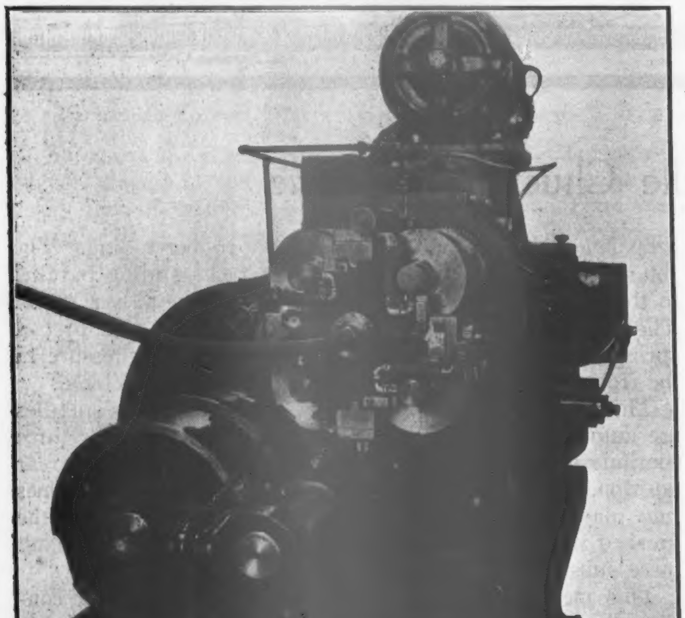
This mechanism is very simple in construction. It consists of a special spindle gear free on the spindle, with a cone clutch seat in a large hub at the rear. Keyed to the spindle, and fitted into this cone clutch seat is a bronze clutch ring. Behind this clutch ring there is a special finger holder in which are pivoted three operating fingers, the front ends of which bear against the chamfered rear face of the clutch ring, while the rear ends work in conjunction with a clutch operating spool. Both finger holder and spool are keyed to revolve with the spindle. As the clutch operating spool is pushed forward, it spreads the fingers which in turn react upon the clutch ring to seat it into the spindle gear, thus driving the spindle. When the spool is withdrawn, the fingers collapse, and a set of spring plungers within the spindle gear unseat



Spindles Equipped for Mechanical Chucking Where Air Is Not Used

the clutch ring, which disconnects the spindle gear from the spindle, and when the spool is withdrawn, its rear face bears against another set of spring pins in the back of the air cylinders which act as brakes to bring the spindle to an immediate standstill.

When any spindle comes into the fourth position, the following action takes place. A cam on a drum at the rear of the machine comes into play to move back a slide which in turn withdraws the clutch operating spool and stops the spindle containing a finished piece of work. As soon as the spindle stops, another cam on the same drum acts to move forward a similar slide which pushes down the plunger of



Spindles Equipped with Individual Connections from the Main Air Line for Automatic Air Chucking

the valve mechanism and so releases the work, which either falls out or is removed by hand. The spindle remains stationary with the clutch open, for a sufficient length of time to allow loading a new piece into the chuck. The cams continue their action by releasing the valve plunger which causes the chuck jaws to close down firmly on the work. As soon as this occurs, the other set of cams moves the clutch spool forward, starting the spindle, and the machine indexes.

While the loading operations are going on in fourth position, the other three spindles are running, and their tools are working, so that no productive time is lost. As the operator will be located at the rear of this machine, the lever for engaging the feed is extended so that it may be operated from either front or rear. On setting up the machines, the air chucks can be operated in any position by a wrench on the squared ends of the valve stems beyond the pinion. This makes it possible to remove work for examination at any stage of machining.

In the mechanically operated chucking machine, the air cylinders are replaced by a special finger holder and cushioned reaction plate actuated by a second spool similar to that used in conjunction with the clutch. The finger holder is mounted upon the draw bar of the chuck behind the end of the spindle. In front of this, and screwed to the end of the spindle is the reaction plate which is a double disc made up of a hardened member against which the fingers bear, and a second disc which carries this upon springs. The finger holder and these two discs are tied together by bolts, the hardened member being free to slide upon these bolts between the other two members. A number of stiff springs in sockets in the member screwed to the spindle keep the hardened disc slightly separated from its mating member.

The spool which operates the chuck is actuated by cams on the rear drum of the machine and slides upon the spindle just in front of the cushioned reaction plate. When it slides to the rear, it spreads the fingers which extend through the slots in the reaction plate. As this takes place, the short arms of the fingers react upon the face of the hardened disc which up to a certain point ordinarily pulls the finger holder back, moving the draw bar with it and closing the chuck. When the piece to be chucked is irregular, the cushion springs will come into play, toward the end of the closing action of the fingers and will allow the hardened disc to depress slightly. This takes the place of the elasticity of the air and insures firm chucking without the possibility of crushing the work or straining the mechanism.

The draw bar is constantly pressed toward the spindle nose by a heavy coiled spring in a pocket in the rear end of the spindle which tends to open the chuck when the fingers collapse. This is not depended upon, however, but a positive opening is insured by a slide similar to that which opens the air chucks. This slide is actuated by a cam on the drum at the rear and carries an arm which presses down upon the end of the draw bar extending beyond the finger holder. Adjustment of the chuck jaws through their entire range is provided by nuts upon the rear end of the draw bar behind the finger holder. The largest chuck which this machine will swing is 6½ in. in outside diameter with a chucking capacity of 4½ in. In special cases, a tool slide feed of five inches is available.

Mounting and Demounting Wheel Press

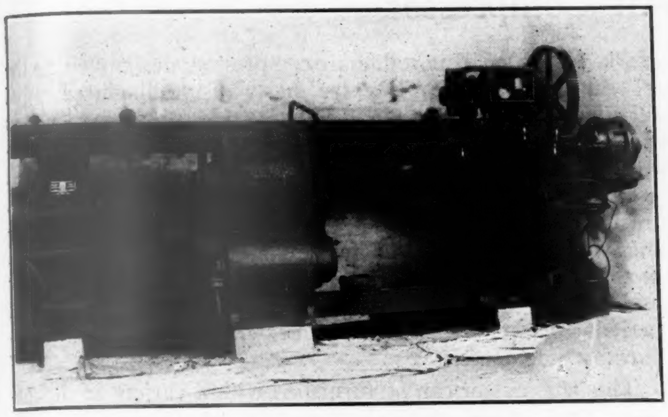
A MOUNTING and demounting wheel press adaptable to railroad car shops has been developed by the Chambersburg Engineering Company, Chambersburg, Pa. The predominating features of this press are its simplicity of design, ease of control, low cost of operation, few moving parts, stationary beams and the single motor drive.

The press is designed to handle car wheels and will force both wheels on or off an axle, simultaneously or one at a time. The press is automatic in its operation. It is especially designed for severe duty and to reduce maintenance and repairs to a minimum. The cylinder beams and the end resistance beam are open hearth steel castings and the cylinders are copper lined. The tension bars are steel forgings and the pump body and valves are made from solid steel.

All the beams are stationary and are provided with large bases, so that the press can be bolted direct to the concrete foundation. All the necessary adjustments for pressing on or off the wheels are made by small, light forcing blocks and sleeves suspended from a trolley. The cylinder beam at the right hand end contains the ram for pressing the wheels on their axles. The center beam is used for pressing wheels off their axles. This beam contains four rams, two for each right and left crosshead, the rams for each head being on a diagonal axis passing through the center of the press. The rams have a long bearing in the beam and are provided with safety valves so that when the plungers reach an outward stroke of 12 inches, the valves blow off, preventing over-travel. The resistance beam at the left hand end, which takes the thrust when forcing the wheels on or off

is provided with a removable steel facing head. It is recessed to permit long shafts to be readily handled in the machine.

Two independent pumps mounted in one body are attached to the right end beam. They are driven by a common eccentric shaft with a six throw eccentric. Each pump has two plungers 3/4 inch in diameter and one plunger 1 3/4 inch in diameter by 6-inch stroke. The eccentric shaft and plungers run continuously from a motor mounted on the press. When the conveniently located operating valves on the front of the press are open, the discharged water is bypassed to the supply tank. When either of these valves is closed, the discharged water is forced either to the right or left hand plungers of the center cylinder beam for demounting wheels. Stop valves in the pipe control the discharged water for the right cylinder beam and when these are set, the water is forced to this cylinders for mounting wheels. The large plungers of each side of the pump have a release valve so that when a pressure corresponding to about 100 tons on the rams is applied, these release valves open and by-pass water from the large plungers. The small plungers continue pumping until the maximum tonnage is reached, when a second set of release valves opens, preventing an excessive pressure. The valve trips are provided on the pump so that a variety of speeds can be obtained on the rams.



Chambersburg Wheel Press Adaptable to Railroad Car Shops

The rams are all made of close grained charcoal iron, turned and finished with a rolling process, thereby giving them a surface which resists the corroding action of water and keeps them smooth and polished. The inside end of the rams is provided with cup leather packing of improved design, arranged with a spring ring to prevent the collapse of the leather and loss of water when the ram is returning. Heavy counterweights are used for the pullback. They are connected to rams with wire ropes running over turned sheaves, thus assuring their rapid return. The right and left hand demounting crossheads, to which are attached the rams of the center cylinder beam, are open hearth steel castings and are provided with removable yokes.

Two assembly trucks on a track and a screw jack are furnished for use in loading and unloading the machine. They are equipped with grooved cups to suit 33-inch, 36-inch, and 38-inch wheels.

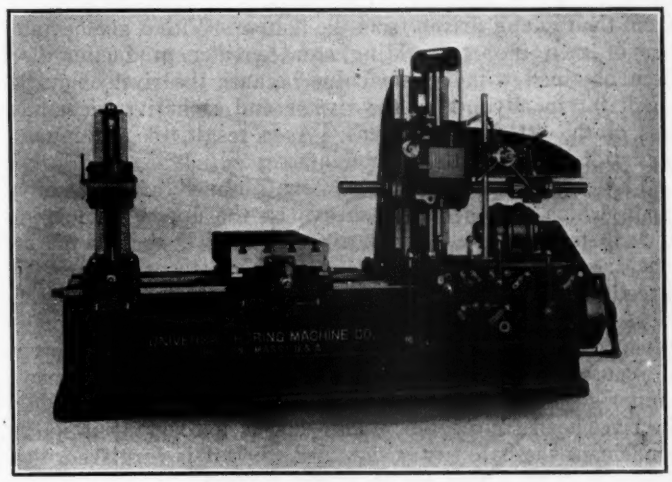
The presses are arranged for either belt or motor drive, as may be desired. When run by motor, a 20-hp. motor hunning at 900 r. p. m. is required for the 200-400-ton press; a 30-hp. motor running at about 900 r. p. m. is necessary to drive the 400-600-ton machine. In both cases if direct current is used, the motor must be compound wound. A guard completely covering the gearing is furnished with motor-driven machines.

Tri-Way Universal Horizontal Boring Machine

The Universal Boring Machine Company, Hudson, Mass., introduced the first tri-way boring machine, which was fully described in the January, 1922, issue of the *Railway Mechanical Engineer*. It was designed with a 4 1/2-in. boring bar, which restricted the spindle speed to 200 r.p.m. In order to overcome this restriction the same company has recently introduced a boring machine with a 2 1/2-in. boring bar which gives a range of spindle speeds from 16 to 650 r.p.m. This provides for slow speeds for heavy milling and high speeds for light drilling.

The tri-way bed has three flat ways; the one in the front and the one in the center furnish guiding surfaces, and the one on the back supports the long carriage. It is rectangular in shape and is thoroughly ribbed and braced so as to prevent springing, even if it should happen to be placed on a poor foundation. A coolant system is provided and the top of the bed slopes to the head end, allowing the coolant to run down into the settling chamber at the end of the bed. From the settling chamber the coolant fluid overflows into another chamber, from which it can be pumped through suitable piping to the work. In addition to this, the new machine contains an oil pump in the head which is geared to the spindle and the drive shaft. This provides a spray of oil for all the gears in the head. The spindle gear box and the head is provided with a sight feed oil gage.

The head is similar to previous models, but is provided with a slow hand feed for the boring bar, and a lever for throwing in the high boring bar speeds. The boring bar reverse lever has been placed on the spindle box instead of on the head. The speed and feed gears are arranged in geometrical progression and located in two trays, the lower tray being filled with oil, and the gears in the upper tray being lubricated by splash and oil vapor. Both the speed and feed boxes are operated on the same principle. The levers for shifting speeds and feeds and for operating them are within easy reach of the operator's right hand. Automatic stops and rapid power traverse are provided in all directions. Located on the head column are two positive



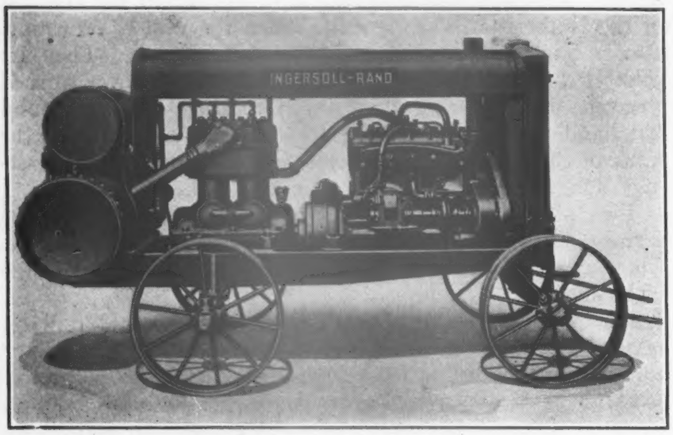
A 2 1/2-In. Boring Machine with a Range of Spindle Speeds from 16 to 650 r. p. m.

stops which prevents the head from running out in either direction on the spindle shaft screw.

The bar reverse is equipped with a Carlyl-Johnson friction clutch. The machine is equipped throughout with S.K.F. ball bearings. A five-horsepower motor with a 25 per cent overload is recommended to drive the machine. Some of the standard specifications for this machine are as follows: The automatic travel of the main boring bar is 20 in. and the travel for resetting is 36 in. The overall size of the table is 20 in. by 42 in. The power crossfeed of the table is 32 in. The power longitudinal feed of the carriage is 24 in. The power vertical feed of the head is 20 in. There are 12 spindle speeds ranging from 16 to 650 r.p.m. The number of feeds in either direction is nine.

Ingersoll-Rand Air Compressor

A SMALL portable air compressor plant of modern design and construction, has been developed and is now being offered by the Ingersoll-Rand Company, New York. This small portable air compressor, designated as the $4\frac{1}{4}$-in. by 4-in. type "Twenty," has a piston displacement of 60 cubic feet per minute and is built along the same lines as the larger type "Twenty" portables. All of the proven features of the larger units are retained, e. g., duplex, vertical compressor, direct-connected to a four-cylinder, four-cycle, tractor type gasoline engine; enclosed construction; circulating water cooling system for engine and compressor with sectionalized-radiator, fan and pump; compressor regulator and engine control for reducing speed during unloaded periods; one-piece cast steel frame; sheet steel roof and removable side doors.



Small Portable Air Compressor

This compressor can be furnished with a variety of mountings; steel wheels and axles; wooden artillery wheels with solid rubber tires and steel axles; on a Ford truck; and on skids for mounting in a car or truck. This and other sizes of type "Twenty" portable compressors are available with either gasoline engine or electric motor drive.

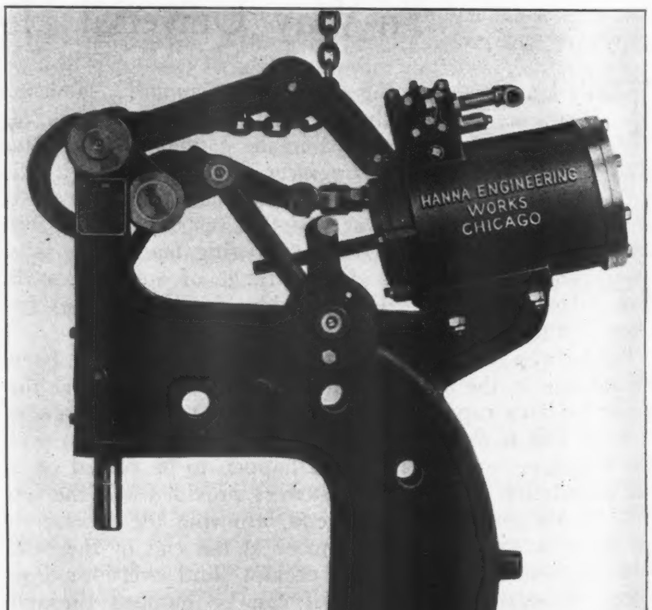
There are four larger Ingersoll-Rand portable compressors having the following piston displacements: 91, 160, 210 and 250 cubic feet free air per minute.

A Plunger Suspension for Riveting Machines

THE plunger suspension arrangement, shown in the illustration, has been developed by the Hanna Engineering Works, Chicago, Ill., as an accessory to its line of pneumatic riveters. Riveters equipped with this mechanism have been improved in their operating characteristics because of the fact that when the riveter is suspended in the position illustrated, the upper die is stationary and the lower die is movable. This permits the rivets to be stuck from the top and driven from the bottom. With a given number of men in an operating crew, greater production has been obtained with this machine because the rivets may be stuck far in advance of the riveter and each rivet demands less of the "sticker-in's" time. As a result, the continuous operation of the riveter is not interrupted.

The suspension is made from the plunger by means of a chain which passes over a sheave on the upper toggle pin. It is then passed under a sheave so placed at the top of the machine that the chain leading to the suspension hook is directly above the center of gravity of the riveter when the die screw axis is vertical. Operation of the mechanism to advance the plunger out of the frame barrel toward the lower die causes the entire frame being lifted. Since the plunger cannot go down, the lower die is forced to rise, thus driving the rivet head from below. This suspension rigging is independent of the bale suspension and when it is furnished, the riveter may be suspended by either method.

Incorporated in this riveter is a mechanism which develops a predetermined pressure uniformly throughout the last half of the piston stroke, or the last $\frac{1}{2}$ in. of rivet die travel, except on machines of over 80 tons, in which case it is the last 1 in. of die travel. This portion of the die stroke, which performs the critical setting of the rivet is, therefore, identical to the stroke characteristics of a hydraulic riveter. Further-



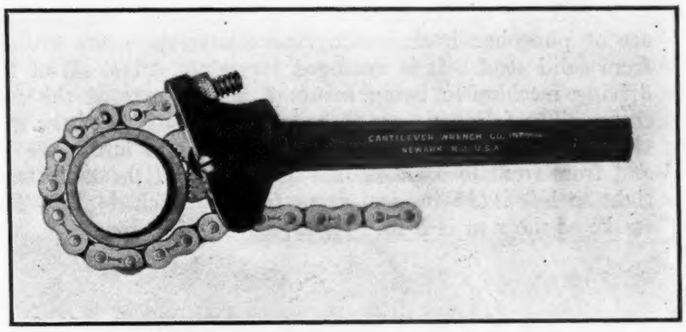
With This Suspension the Upper Die Is Stationary and the Lower Is Moveable

more, the early part of the die stroke, in which very little actual work is done on the rivet, is accomplished at an average leverage of 2 to 1, as compared to 12 to 1 for the uniform pressure portion of the stroke. Thus, the clearance gap between the dies is closed at a relatively small power consumption, while the heading of the rivet is performed under known conditions. This occurs without any adjustment of the die screw.

Reversible Chain Pipe Wrench

THE Cantilever Wrench Company, Newark, N. J., has recently placed on the market a chain pipe wrench which is especially well adapted to pipe work in shops or on locomotives where working space is restricted. The principal features of construction are simplicity, ease of replacement of parts and light weight. The reversible feature enables the user to put the chain on either side of the pipe and insures an easy ratchet motion which reduces to a minimum the chances for the chain to jam or for the wrench to slip. An adjusting nut is provided which can be used in tightening up the chain grip when working in very restricted spaces such as on coil pipe work. It can be used on any pipes that are far enough apart to slip the chain between them.

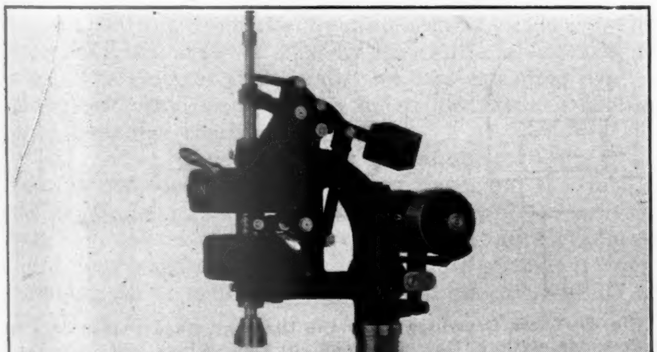
The design of this tool is such that it grips the pipe in any position. The direction of rotation can be reversed instantly without the necessity of removing the hands from the handle. This wrench is made in seven models suitable for use on pipe sizes from ½ in. to 12 in. and can be used not only as a pipe and fitting wrench, but also as a chain pipe vise.



The Chain and Jaws of This Pipe Wrench Grip Instantly in Any Position

Garvin Automatic Tapping Machine

THE Garvin Machine Company, New York, has redesigned its automatic tapping machine, the principal feature embodied in the new design being the addition of 12 Timken bearings which support the spindle pulleys, the idler pulley and the complete back shaft assembly section.



Important Rotating Parts Are Equipped with Timken Roller Bearings

The entire operation of this machine is controlled by a slight downward pull on the starting hand lever, after which the machine is entirely automatic. The spindle is fitted with two friction pulleys driven in opposite directions by one continuous belt. Between these pulleys is a double-faced friction clutch keyed to the spindle. This clutch is connected with the hand lever at the right, by a toggle mechanism which is quickly and easily adjustable to any desired tension.

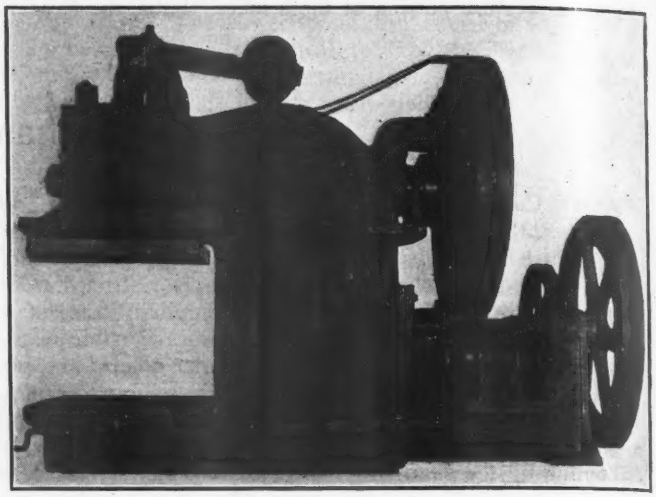
The previous driving pulley had an extended hub, which assembled into the head, and which revolved with the pulley. This hub formed not only the support for the pulley but also provided the bearing for the spindle. Thus both spindle and spindle bearing revolved and a tight belt could cause a cocked position, or cause excessive wear on the spindle box. To overcome this trouble the extended hub was done away with and it is now mounted on roller bearings. They are mounted on the stationary bronze spindle sleeve so that the pull is in direct line with the center of the bearing, and is in no way transmitted to the spindle. This construction gives additional support for the pulleys, eliminates the possibility of "cocking," and at the same time allows the long, stationary bronze sleeve to become the bearing for the spindle.

The table improvements include deep oil channels and a large drain into the oil reservoirs, eliminating the chance of disagreeable operating conditions due to oil clogging. The tee slots of the table are planed out of the solid for proper and ample clamping. The table is mounted on an arm that adjusts by rack, and locks in any desired up or down position, and it also swings around the column. The machine is simple to operate and contains various adjustments to safeguard against spoiling any work or damaging the machine to any extent.

Heavy Duty Single End Punching Machine

A HEAVY duty beam punch which is adapted to the perforating of steel plates and structural shapes that enter into car construction has recently been placed on the market by the Beatty Machine & Mfg. Company, Hammond, Ind. The principal feature of this machine is in the die space which must be large enough to assemble tools on it for production work. This permits the assembling on the machine in one setting of the necessary tools required to complete a piece of work, such as a center sill web plate, finishing all of the punching, coping and slotting in one pass through the machine.

The frame of the machine is of semi-steel; the bearings are of phosphor bronze with ring oilers; the gears are cut from solid steel. It is arranged for motor drive, all of the driving mechanism being mounted at the rear of the machine. The following are the general dimensions of the machine. The width of the ram from right to left is 34 in. and from front to back 42 in. The width of the table from right to left is 34 in. and from front to back 44 in. The stroke of the ram is 3 in. Its capacity is 240 tons.



Punching Machine Equipped with a Hand Operated Spacing Table

Gage for Determining the Wear on Diamonds

THERE has been a large increase in the use of diamonds for dressing grinding wheels in railroad shops during the past few years. As a rule they have been used according to the discretion of the individual operator, subject to some supervision by the foreman as to the proper length of time a diamond should be kept in service before resetting. It quite often occurs that a particularly hard diamond finds great favor with the operator, and consequently he frequently prefers to continue to keep the diamond in service for too great a time with the possible danger of imperiling the life of the diamond.

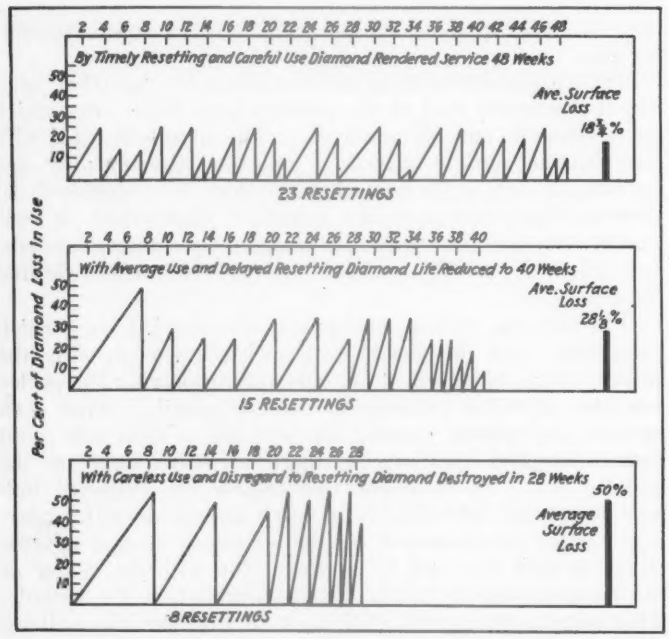


Fig. 1—Comparative Charts Showing the Average Life of Diamonds of the Same Quality and Size

It is generally recognized that the hard outer surface of a diamond gives the longest life, and by properly resetting the diamond it is possible to utilize the maximum outer surface. A diamond that has been worn to a very flat surface requires greater pressure to dress the wheel. As a result, a greater amount of heat is generated and the diamond is liable to break and disintegrate.

There is reproduced in Fig. 1 some comparative charts showing the average life of diamonds of the same quality and size. This chart is the result of records taken from tests made by the Joyce-Koebel Diamond Company, Inc., New York, on crankshaft grinding. The top chart shows the result of timely resetting and careful use of the diamond, which lasted over a period of forty-eight weeks. The middle chart is the result of average use and delayed resetting which reduced the life of the diamond to forty weeks. In this case the diamonds provided 16½ per cent less service. The bottom chart shows the result of giving a diamond only eight resettings, thus shortening the life to twenty-one weeks, or approximately 58 per cent of the service which could have been rendered.

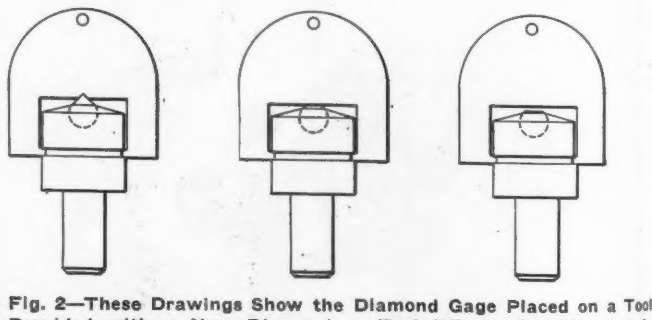


Fig. 2—These Drawings Show the Diamond Gage Placed on a Tool Provided with a New Diamond, a Tool Where the Diamond Is Ready for Resetting and Again Where the Diamond Has Been Worn Below the Safety Level

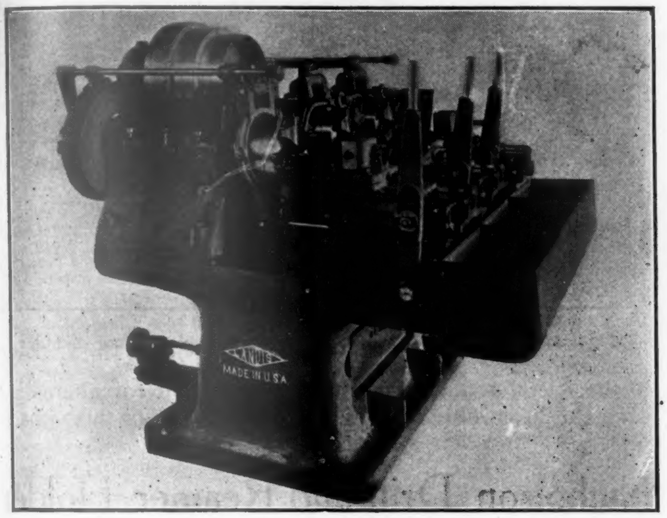
In order to overcome this difficulty a diamond gage, which is used in conjunction with a grooved diamond tool, has recently been designed by this company, patents for which are now pending. The drawings in Fig. 2 show the manner in which the new gage is applied to the grooved tool. The amount that a new diamond may be used with safety can be readily determined by the gage as shown in the center drawing. A diamond should never become worn below the

safety point, which is shown in the drawing on the right. The gage is standard, but the groove is varied and registers according to the size and shape of the diamond. Its application is such that the gage may be used without removing the diamond holder from the machine. It can be supplied for all types of diamond holders. Each time the diamond is reset a new holder is supplied, which is grooved to permit the diamond to be worn to a point of safety.

Landis Bolt Threading Machine

THE Landis Machine Company, Waynesboro, Pa., has placed on the market a new thread cutting machine. It is made in 1-in. and 1½-in. sizes in double and triple head types and in a 2-in. size in the double head type.

The spindles on the machine are located sufficiently close together to permit an operator to handle a three-head machine without shifting from one lever to another. They are independent and are controlled by the clutches located at the rear. The clutches are operated by bars extending over the die heads. Any one head may be stopped without shutting down the entire machine.

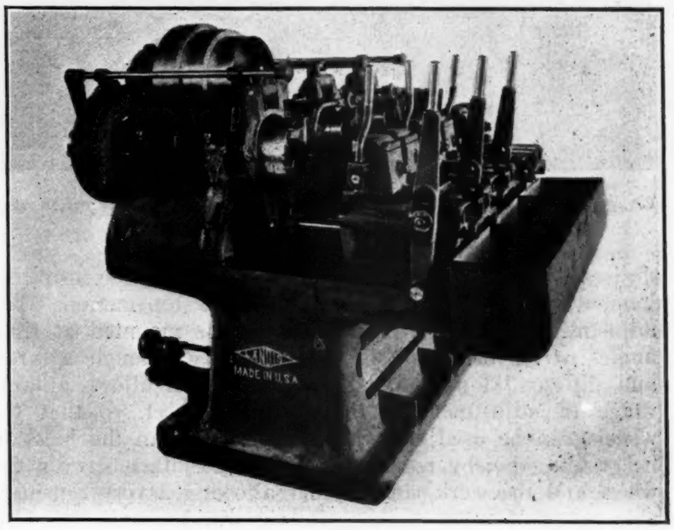


Landis Bolt Threader with Carriage Equipped with Vise Grips

The die heads are opened and closed automatically. The tripping rods which connect the carriage and the yoke of the die heads for opening and closing them, are provided with stop collars and are conveniently and quickly adjusted for various lengths of threads. All spindle gears have bronze bushings. The main bearings are capped and may be adjusted for any wear.

The carriage drive is in the center and comprises a rack and segment gear. These parts are thoroughly protected against dirt and chips. The levers operating the carriages are adjustable through a vee-toothed clutch which permits of a convenient position of the levers when cutting different lengths of thread. The levers may also be quickly changed from one side to the other side of the carriage.

The carriages on the machine are furnished with either bolt holders or vise grips. They are easily taken off and quickly applied. Both have horizontal as well as vertical adjustment so that the work may be in proper alinement at all times. The vise grips are lever operated which facilitate production. The grips, which are separate from the sliding jaws, are hardened and are quickly changed without disturbing any adjustments. The machines are furnished with boxes for holding the bolts. These boxes are placed on the front of the machine, where they will not interfere in any manner with the operator, and may be removed when threading long bolts. A geared oil pump supplies an abundant flow of lubricant to the die head. All moving parts are protected so as to eliminate any danger of an accident.



Bolt Threading Machine with Automatic Die Head Bolt Holders

Internal Grinder for Locomotive Cylinders

KNOWING the satisfactory results obtained from grinding applied to small cylinders, the Churchill Machine Tool Company, Ltd., Manchester, England, has designed an internal grinder to handle locomotive cylinders. This machine can be used for generating holes in exact relationship and at correct center distances from previously finished locating surfaces or slides, thus insuring alinement with the minimum of correction by hand work.

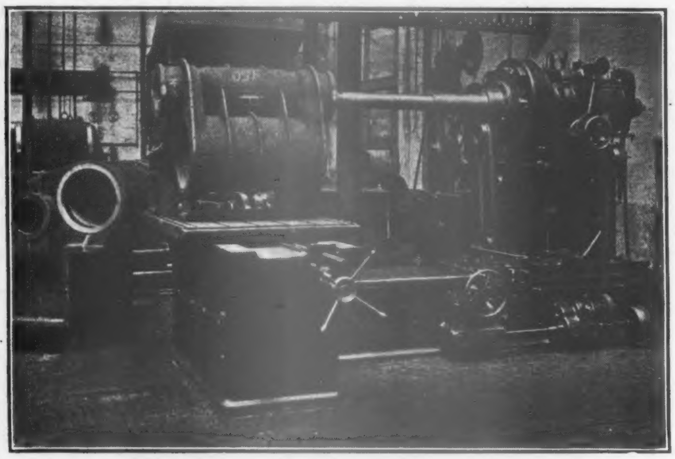
The machine is designed with a massive table with cross adjustment only for positioning the work, the table remaining stationary while the grinding is proceeding. It is carried on a base reaching directly to the floor, and, while coupled to the machine, is independent of it, so that it can be fitted to suit the exigencies demanded by various classes of work. If necessary the table can be removed and a base-plate substituted.

The grinding wheel spindles are provided with the necessary planetary motion, adjustable while grinding is proceeding, and are carried on a head which is vertically adjustable on a column. The column is mounted on a horizontal slide having an automatic longitudinal motion along the bed, controlled by adjustable reversing dogs for varying the stroke to suit the length of the hole to be ground. This slide is provided with various changes of speed for use while grinding, and on the No. 3 size machine there is an additional quick traverse, independent of the ordinary reversing dogs,

which can be brought automatically into action for traversing at high speed through the chambered portion of long holes.

The main spindle, on which is mounted the grinding wheel spindle, is also provided with various changes of speed, any of which can be brought into operation independent of the traverse speeds. The grinding wheel spindles are easily detachable from the main spindle, and can be changed in a few minutes for larger or smaller sizes. A full range of spindles is made.

The planetary motion to the grinding wheel spindles is



Churchill No. 3 Internal Grinder Truing the Valve Chamber of a Locomotive Cylinder

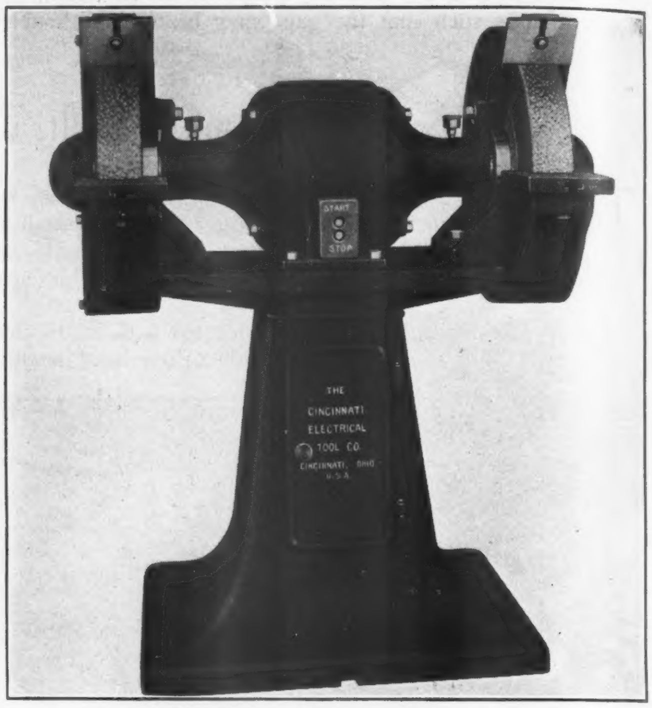
designed to permit especially sensitive control, the controlling hand wheels being provided with a dead stop motion. The adjustment is obtained direct on a slide mounted at right angles to the main spindle, and operated through a screw and differential motion. This construction allows a large range of adjustment to the grinding wheel, so that the wheels can be used considerably smaller than the holes to be ground, thereby reducing the arc of contact between the wheel and the work, and further allowing a very considerable range of wear to the grinding wheel.

By means of a cross adjustment of the table and the vertical adjustment of the spindle, articles having a number of holes can be ground without disturbing the setting of the work on the table. Within the capacity of the machine there is no limitation to the external shape of work which may be dealt with. The machines are self-contained in all their motions, being driven from a single overhead countershaft, or by a direct coupled constant speed motor.

Heavy Duty Floor Grinder

THE Cincinnati Electrical Tool Company, of Cincinnati, Ohio, has recently added to its line of portable electric drills, grinder and buffers a 5-hp. heavy duty floor grinder, suitable for heavy grinding of all kinds in railroad shops. The motor is equipped with fully enclosed ball bearings, which prevent emery dust and dirt from getting into the bearings and windings, thereby increasing the life and efficiency of the machine. The ball bearings are correctly locked to the shaft to provide end thrust and also to eliminate wear and friction. This grinder will carry wheels up to 18 in. in diameter by 3 in. face. The wheel guards are of the exhaust type, complying with all safety standards, and are adjustable for wear of the wheels. Removable covers bolted to the guards completely enclose the sides of the wheels, flanges and nuts, ensuring safety to the operator.

The starting switch is of the magnetic type, push-button control and is mounted on a separate panel within the column. It is readily accessible and insures ample protection

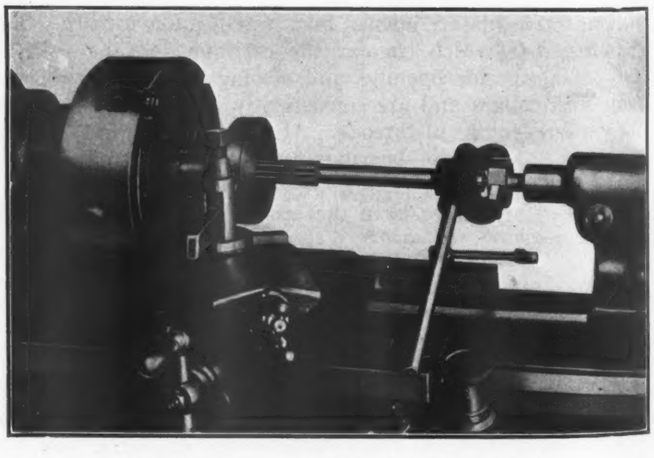


Cincinnati Electrical Two-Wheel Motor Driven Floor Grinder

to the operator. This machine may be had for alternating current 220 or 440 volts, 25 to 60 cycles, two or three phase.

Nicholson Drill and Reamer Holder

W. H. NICHOLSON & COMPANY, Wilkes-Barre, Pa., has recently put on the market a drill and reamer holder which can be used either on a lathe or a drill press. When using it on a lathe, the holder takes the place of the live center and acts as a dog, driver and hold-back. It can also be used in a turret lathe and screw machine, where



Nicholson Reamer Holder Applied to a Lathe

it acts as a floating holder. In this capacity it eliminates the adjusting of bolts or screws and also the changing of bushings. When used on a drill press where it furnishes a strong, positive drive. Hardened steel plates are used to line up the drills and the center holds them in alinement, reducing bell-mouthed holes to a minimum. These holders are furnished in any taper or straight shank required up to 1½ in. in diameter.

GENERAL NEWS

The car repair shops of the Baltimore & Ohio at Sandusky, Ohio, were reopened on August 18 after being closed since January 26.

The shops of the Delaware & Hudson at Colonie, N. Y., report that from April 21 to August 4 the 1,000 employees in the shops worked 1,000,000 hours without a man being hurt.

Shopmen employed in the main shops of the Canadian National at Montreal, Que., and Stratford, Ontario, have voted in favor of closing down one week in each month rather than to have a number of the men laid off altogether. The other shops of the Central region, in which region the vote was taken, decided against the plan of closing down one week each month, preferring the layoff system. The decision of the men has been accepted by the management.

46.8 Per Cent of Locomotives Found Defective

Of 5,460 locomotives inspected by the Bureau of Locomotive Inspection during July, 2,553 or 46.8 per cent were found defective and 282 were ordered out of service, according to the Interstate Commerce Commission's monthly report to the President on the condition of equipment. During the first six months of 1924, of 34,174 locomotives inspected, 17,482 or 51 per cent were found defective and 2,842 were ordered out of service. Of 95,047 freight cars inspected by the Bureau of Safety during July, 3,692 or 3.9 per cent were found defective and of 2,162 passenger cars 25 were found defective. During the month 40 cases, involving 123 violations of the Safety Appliance Acts, were transmitted to various United States attorneys for prosecution.

New Locomotive Repair Shops for Southern

This company has awarded a contract to the Foundation Company for the design and construction of new locomotive repair shops at Atlanta, Ga. The main building will be a double transverse erecting and machine shop for locomotives, about 325 ft. long and over 300 ft. wide. It will be of steel construction with brick walls, and will provide facilities for two 200-ton electric traveling cranes and several smaller cranes, some of which will be located inside the building and others in the yard. The new shops will require additional boiler capacity in the power plant, which work is included in the contract. Designs are being prepared by the Foundation Company collaborating with the railroad company's engineers. Construction will be started in about three weeks. It is estimated that it will take six months to finish the contract, and the total cost will be over $750,000.

N. Y. C. Veterans' Summer Home

The New York Central Veterans' Association has bought a camp at Lake Placid, N. Y., consisting of 35 acres of land and 14 buildings and is putting the buildings and facilities in order for use the present summer, as a vacation resort for the members of the association. Lake Placid is in the Adirondack Mountains about 125 miles north of Utica, and is a noted resort in winter as well as in summer. The buildings and improvements on the grounds represent a cost of $125,000, but the whole establishment has been bought at an attractive price.

The privileges of the camp are primarily for members of the Veterans' Association but other employees of the railroad will probably be admitted at a small advance in the rates over those charged to members, the purpose being to make the fullest possible use of the facilities. The nine principal buildings, after some slight alterations, will accommodate 125 guests. The Veterans' Association now numbers about 1,000 members. The president is William O. Wichman, locomotive engineman; secretary, J. M. Wooldridge, a chief clerk in the legal department, New York City. Employees of the road are eligible to membership after 20 years' service, 15 years of which must have been continuous.

Locomotive Inspector Indicted for Perjury

Robert Addison, a locomotive inspector of the Boston & Maine, was indicted in the Federal Court at Albany, N. Y., last May for perjury, in the signing of a report which he had made in January last, wherein he declared that the tubes in locomotive No. 3009 were in good condition. Upon investigation by the Interstate Commerce Comimssion of the blowing out of one of the boiler tubes while this engine was passing through Hoosac Tunnel, on February 14, when scalding water was discharged into the cab, scalding the engineman and fireman, it appeared that Addison had in regular form certified that the tubes of this engine were in good condition when, in fact, the center arch tube did not extend through the throat sheet sufficiently to permit it to be belled or headed. The government contends that Addison had himself installed this particular tube and was aware that it was not in safe condition.

Attorney General Stone announces that he intends to urge a speedy trial of this case, deeming it the duty of the Department of Justice to give vigorous support to the Interstate Commerce Commission in its work of promoting the safety of locomotive operation.

Attorney General Stone in his statement refers to the need of additional inspectors for the 76,000 locomotives in the country, a need which has been pointed out by the Interstate Commerce Commission in its annual reports. The penalty for violation of the locomotive inspection law is comparatively small, whereas perjury, if proved in court, may be punished more severely.

It is expected that Addison will be tried at Auburn, N. Y., on October 7 next.

The Department of Justice is said to be in favor of amending the law so as to provide that when railroad inspectors overlook patent defects, they can be adjudged guilty of criminal negligence and the railroad officers held jointly responsible for the negligence of employees.

Program of German Railway Congress

The railway technical congress to be held in Berlin on September 22-27, under the auspices of the Society of German Engineers and the German State Railways will consider, among other things, the following subjects:

Freight transportation, with reference to heavy cars, rapid unloading and the relationship of these cars to bridges and tunnels.

Locomotive progress—thermal efficiency, steam condensation, turbine and Diesel locomotives, screw-shaped flues, pulverized coal, iron flues, economy of internal combustion locomotives.

Electrification and signaling.

Shop practice.

Passenger and transfer stations, operating questions, subaqueous tunnels, switching.

The exhibits in connection with the congress will be most extensive. More than 100 various types of locomotives and motor cars will be on view, including over 50 different types of steam locomotives, 10 electric locomotives, 6 Diesel locomotives, sundry compressed air, fireless and internal combustion engines and a turbo-locomotive. All kinds of freight and passenger cars will also be on exhibit. There will be a special demonstration of yard operation and various diagrams, films, and models will be available through the co-operation of the Berlin-Charlottenburg Technical Institute. One day will be devoted to brake tests on a 90-axle passenger train.

F. K. Loeffler, president of the Techno-Service Corporation, 46 West Fortieth street, New York, whose company is the American agent of the Borsig Company, the German locomotive

builders, has volunteered to give whatever further information is desired to persons from the United States or Canada, who may be interested in attending the congress.

Union Officers to Serve Prison Term

Five officers of the Federated Shop Crafts, who were found guilty by the United States District Court at El Paso, Tex., of a charge of conspiracy to interfere with interstate commerce during the shopmen's strike in 1922, must serve their prison sentences and pay their fines, according to a decision by the United States Supreme Court upholding the District Court. The men, who were convicted of putting quicksilver in Southern Pacific locomotives at El Paso and San Antonio, were each sentenced to 10 months in prison and to pay a fine of $2,500. In spite of the efforts of a large array of defense attorneys, the men were convicted before United States Judge Smith at El Paso in January, 1923. Subsequent appeals to the United States Court of Appeals at New Orleans and to the Supreme Court resulted in affirmations of the decree of the District Court.

Great Northern Holds Stores Convention

What is believed to be the first system convention of store officers on an American railroad was held at Great Falls, Mont., on July 23 and 24 by the Great Northern Stores Association as the first of a series of meetings which it is proposed to hold annually from now on. The meeting, which was conducted under the direction of Robert Steel, district storekeeper, Great Falls, included addresses by Howard Hayes, general storekeeper of the system, and president of the Association, O. H. Wood, assistant purchasing agent, and I. Parker Veazy, Great Northern attorney for Montana.

Other business included a report on the meeting of the Purchases and Stores section of the American Railway Association at Atlantic City by C. E. Talmadge, assistant general storekeeper; motion pictures of supply train operation over the Northern Pacific and of shop delivery practices on the Southern Pacific; together with the presentation and discussion of reports and papers prepared by members on the following subjects: Stores Department Accounting, Specifications for Trays and Shelving, Material Classification, Facilities for Handling Material, Supply Car Operation; Delivery of Material to Shops, Yards, and Repair Tracks; and Storekeeping Methods for Forest Products.

The association, which is newly organized, has for its object the improvement of methods and practices used in the ordering, handling, storage, and distribution of materials and the accounting in connection therewith. Its membership is composed of active and associate members, local storekeepers, division and district storekeepers and their assistants, chief clerks and general foremen at general and district stores, together with the general storekeeper and his assistants, constitute the active members while associate members include such other employees in the purchases and stores organization as are admitted to the organization by action of a general committee. Provision is also made for honorary members.

The general storekeeper and the assistant general storekeepers are ex-officio president and vice-presidents, respectively, of the association, while the management of the activities is conducted by a general committee consisting of three members selected by the association annually at its regular meeting from among members proposed by a nominating committee which is also elected at each anual meeting. The General Committee makes the necessary arrangement for the meetings of the association, conducts the general meetings, selects and appoints the members of all standing and special committees, and examines all the communications, papers and reports intended for presentation to the association deciding which of them or what portions of them shall be presented. A. L. Nelson, district storekeeper at Hillyard, Wash., was elected chairman of the general committee for the ensuing year.

MEETINGS AND CONVENTIONS

Third Machine Tool and Engineering Exhibition

Particular interest will attach to the exhibition of machine tools and accessories to be held at the Olympia, London, England, September 5 to 27, on account of the fact that the British Empire Exhibition and other events have attracted thousands of visitors from all parts of the world to London. This exhibition is the third of its kind organized by the Machine Tool Trades Association, and in view of the fact that three or four years will elapse before it is repeated, it is expected that engineers from all parts will attend. The machine tool exhibition, in conjunction with the Palace of Engineering at Wembley, will provide an excellent opportunity for engineers to acquaint themselves with the quality of British engineering productions.

Lord Askwith, K. B. E., K. C., will have charge of the opening ceremony on Friday, September 5. The exhibition will be open to the public so that those present will be able to witness the formal opening. The luncheon following the ceremony will be attended by the members of engineering institutions throughout the country. The whole of the machinery, which is representative of all British machine tool interests, will be running during the exhibition.

LOCOMOTIVE REPAIR SITUATION—FORMER METHOD OF COMPILATION

Date, 1923	No. locomotives on line	No. serviceable	No. stored serviceable	No. held for repairs req. over 24 hours	Per cent	No. held for repairs req. less 24 hours	Per cent	Total held for repairs	Per cent
January 1	64,453	48,905	576	13,587	21.1	1,962	3.0	15,549	24.1
April 1	64,559	50,107	914	12,801	19.8	1,651	2.6	14,452	22.4
July 1	63,906	52,456	2,181	10,326	16.2	1,124	1.8	11,450	18.0
October 1	63,982	54,159	2,620	8,789	13.7	1,034	1.6	9,823	15.3
1924									
January 1	64,406	54,031	5,061	9,395	14.6	980	1.5	10,375	16.1

LOCOMOTIVE REPAIR SITUATION—NEW METHOD OF COMPILATION

Date, 1924	No. locomotives on line	No. serviceable	No. stored serviceable	No. req. classified repairs	Per cent	No. req. running repairs	Per cent	Total req. repairs	Per cent
February 1	64,377	53,586	4,116	5,919	9.2	4,872	7.6	10,791	16.8
March 1	64,431	53,127	3,800	6,047	9.4	5,257	8.1	11,304	17.5
April 1	64,363	52,805	4,648	6,128	9.5	5,430	8.4	11,558	17.9
May 1	64,330	52,890	6,079	6,105	9.5	5,335	8.3	11,440	17.8
June 1	64,373	53,498	6,661	6,099	9.5	4,776	7.4	10,875	16.9
July 1	64,416	53,382	7,117	6,035	9.4	4,999	7.7	11,034	17.1
August 1	64,486	53,381	7,152	6,073	9.4	5,032	7.8	11,105	17.2

FREIGHT CAR REPAIR SITUATION

Date, 1923	Number freight cars on line	Cars awaiting repairs			Per cent of cars awaiting repairs	Month	Cars repaired		
		Heavy	Light	Total			Heavy	Light	Total
January 1	2,264,593	164,041	51,970	216,011	9.5				
April 1	2,296,997	154,302	52,010	206,312	9.0				
July 1	2,260,532	146,299	44,112	190,411	8.4	June	121,077	2,451,758	2,572,835
October 1	2,270,840	118,563	32,769	151,332	6.7	September	114,064	2,335,161	2,449,225
November 1	2,263,099	116,084	34,540	150,624	6.6	October	117,254	2,444,118	2,561,372
December 1	2,270,405	116,697	38,929	155,626	6.8	November	104,761	2,214,617	2,319,378
1924									
January 1	2,279,363	118,653	39,522	158,175	6.9	December	87,758	2,073,280	2,161,038
February 1	2,269,230	115,831	45,738	161,569	7.1	January	76,704	2,083,583	2,160,287
March 1	2,262,254	119,505	49,277	168,782	7.5	February	70,056	2,134,781	2,204,837
April 1	2,274,750	125,932	46,815	172,747	7.6	March	77,365	2,213,158	2,290,523
May 1	2,271,638	131,609	47,666	179,275	7.9	April	75,352	2,074,629	2,149,981
June 1	2,280,295	138,536	50,683	189,219	8.3	May	73,646	2,130,284	2,203,930
July 1	2,279,826	144,912	49,957	194,869	8.5	June	70,480	1,888,899	1,959,379
August 1	2,278,773	153,725	49,139	202,864	8.9	July	72,347	1,567,430	1,639,777

General Foremen's Association Convention

The topics to be discussed at the convention of the International Railway General Foremen's Association, which will be held at the Hotel Sherman, Chicago, September 9 to 12, inclusive, are as follows: (1) Steel Car Repair Facilities and Methods of Repairs to Various Parts of All Classes of Steel Cars; (2) Labor Saving Devices Other Than Those Sold or Patented (Shop Organization from General Foreman Down); (3) Terminal Inspection, Running Repair Costs and Repair Work Practices; (4) Maintenance of Superheaters; Feed Water Heaters; Locomotive Stokers and the Locomotive Booster.

Safety Congress in Louisville

The Thirteenth Annual Safety Congress of the National Safety Council will be held in Louisville, Ky., from September 29 to October 3.

The program of the Steam Railroad Section is as follows:

September 30

1. Better Management Through Co-operation, by Henry Bruère, Third Vice-President, Metropolitan Life Insurance Company.
2. Report of Officers.
3. Development of Safety on the Railroads, by Charles Frederick Carter, New York Central.
4. Reports of Committees.
5. Safety and Fire Prevention.

October 1

Election of Officers.
Safety from the Standpoint of:

1. The Transportation Department, by E. G. Neumann, Union Pacific.
2. The Car Department, by W. A. Clark, General Car Foreman, Duluth, Missabe & Northern.
3. The Track Department.
4. The Locomotive Engineer, by D. J. Buckley, Locomotive Engineer, Baltimore & Ohio.
5. The Shopman.
6. The Conductor.
7. The Trainman, by F. G. Kileen, General Chairman, Wabash, Brotherhood of Railroad Trainmen.

Safety Inspectors' Session—October 2

1. Presentation of Inspector's Problems, by J. A. McNally, Safety Inspector, Wabash.
2. Organizing and Maintaining Interest Among Committeemen, by H. Corbin, Supervisor of Safety, Atlantic Coast Line.
3. Acquiring a Safety Conscience, by W. L. Allison, Baltimore & Ohio.
4. Getting Co-operation of Local Safety Committeemen, Local Officers and Labor Representatives, by D. E. Satterfield, Safety Inspector, Chesapeake & Ohio.
5. Interesting the Individual in Safety Work, by J. A. Clancy, Safety Representative, New York, New Haven & Hartford.
6. General Discussion.

Car Inspectors' and Car Foremen's Association Convention

The following program has been arranged for the convention of the Chief Interchange Car Inspectors' and Car Foremen's Association of America, which will be held at the Hotel Sherman, Chicago, September 23, 24 and 25:

September 23

10:00 a. m.
Invocation.
Address by president.
Address by R. H. Aishton.
Report of Entertainment Committee.
Report of secretary and treasurer.
Address—Freight Claim Prevention, by Joe Marshall, special representative, American Railway Association.
Discussion.

2:00 p. m.
Efficiency and Heavy Car Repair Shop Operation, by H. W. Williams, special representative to general superintendent motive power, C. M. & St. P.
Treatment of Journal Lubrication, by H. O. Drody, service engineer, Galena Oil Company.
Automobile Loading in Closed and Open Cars, by P. Alquist, master car builder, Pere Marquette.
Discussion.

September 24

9:30 a. m.
Steel Car Repairs, by J. A. Roberts, Chief A. R. A. clerk, Chesapeake & Ohio.
A. R. A. Billing, by B. F. Jamison, special traveling auditor, Southern railway.
Discussion.

2:00 p. m.
Question Box Committee report and discussion of Billing Rules.

September 25

9:30 a. m.
Extension—Question Box Committee.
Discussion of A. R. A. Rules of Interchange.

2:00 p. m.
Election of officers.
General discussion.
Adjournment.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

American Railway Association, Division V.—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago.
Division V.—Equipment Painting Division.—V. R. Hawthorne, Chicago.
Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York.

American Railway Tool Foremen's Association.—J. A. Duca, tool foreman, C. R. I. & P., Shawnee, Okla. Annual convention September 3, 4 and 5, Hotel Sherman, Chicago.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 23 West Forty-third St., New York.

American Society for Steel Treating.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Next meeting September 22-26, inclusive, at Boston, Mass.

American Society for Testing Materials.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting October 20-24, Hotel La Salle, Chicago.

Canadian Railway Club.—C. R. Crook, 129 Sharron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill. Next meeting September 8, 8:00 p. m. The meeting will be addressed by E. Von Bergen, air brake and lubricating engineer, Illinois Central, who will talk on the subject of hot boxes.

Car Foremen's Association of St. Louis.—R. E. Giger, 721 North 23rd street, E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings second Thursday, January to November. Interim meetings second Thursday, February, April, June, Hotel Statler, Buffalo, N. Y. Next meeting September 11. A paper on Smooth Handling of Trains, covering both passenger and freight trains, will be presented by E. R. Boa, road foreman of engines, New York Central.

Chief Interchange Car Inspectors' and Car Foremen's Association.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago. Annual meeting Hotel Sherman, Chicago, September 23, 24 and 25.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November. Next meeting September 9. Dinner and addresses.

Cleveland Steam Railway Club.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month at Hotel Cleveland, Public Square, Cleveland.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

International Railway Fuel Association.—J. B. Hutchinson, 6000 Michigan Ave., Chicago, Ill.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash St., Winona, Minn. Annual convention September 9 to 12. Hotel Sherman, Chicago.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meetings second Tuesday in month, except June, July, August and September, Copley-Plaza Hotel, Boston, Mass.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth St., New York. Next meeting September 19, 8 p. m. James Paterson, managing director, Carter-Paterson, Ltd., London, England, will read a paper on Store Door Delivery and British Motor Shipping Methods. W. L. Bean, assistant mechanical manager, New York, New Haven & Hartford, will discuss the Rail Motor Car.

Niagara Frontier Car Men's Association.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y. Regular meetings January, March, May, September and October.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings second Thursday in month, alternately in San Francisco and Oakland, Cal.

Railway Club of Greenville.—G. Charles Hoey, 27 Plum St., Greenville, Pa. Meetings last Friday of each month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings second Friday in month, except June, July and August. Next meeting September 12. A paper on The Railroads of Manchuria will be read by B. B. Milner, mechanical engineer, Missouri-Kansas-Texas, Parsons, Kans. Moving picture film South Manchurian railways.

Southeastern Carmen's Interchange Association.—J. E. Rubley, Southern railway shops, Atlanta, Ga.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting Hotel Sherman, Chicago. September 16, 17, 18 and 19.

Western Railway Club.—Bruce V. Crandall, 605 North Michigan Ave., Chicago. Meetings third Monday in each month, except June, July and August.

SUPPLY TRADE NOTES

D. M. French, mechanical engineer of the Gill Railway Supply Company, with headquarters at Peoria, Ill., has been transferred to Chicago.

The Consolidated Machine Tool Corporation of America has removed its Colburn Machine Tool Works from Cleveland, Ohio, to its Betts Machine Works, Rochester, N. Y.

F. A. Keihn, formerly of the engineering department of the International Motor Company, has been appointed sales engineer, automotive car division, of the J. G. Brill Company.

The Shelton Adjustable Double Deck Car Company has opened offices at 1019 Monadnock building, San Francisco, Cal., and will manufacture and sell an adjustable deck for freight cars.

Theodore B. Counselman has been appointed western representative of the Clark Car Company, Pittsburgh, Pa. Mr. Counselman has his headquarters at 122 South Michigan avenue, Chicago.

The Hanna Engineering Works, 1765 Elston avenue, Chicago, is now represented in Maine, New Hampshire, Vermont, Massachusetts and Rhode Island by the Eggleston Supply Company, 259 Franklin street, Boston, Mass.

R. L. Mead, engineer and salesman for the Brown Hoisting Machine Company, has been appointed western sales manager of the Ohio Locomotive Crane Company, with headquarters in the Railway Exchange building, Chicago.

The Fairmont Railway Motors, Inc., has opened a Pacific coast branch office at 637 Mission street, San Francisco, Calif. R. W. Jamison has been appointed district sales manager for the states of California, Washington, Oregon and Nevada.

David E. Drake, of the sales department of the Westinghouse Electric & Manufacturing Company, has retired at the age of 76 after a career of 50 years in the electrical industry, 34 of which were spent in the service of the Westinghouse Company.

The American Locomotive Company has awarded a contract to the Chicago Bridge & Iron Works for the furnishing and erecting of a 50,000-gal. tank on a 100 ft. tower at its Richmond, Va., plant. The tank will be used for the purpose of affording fire protection.

L. G. Coleman, assistant general manager of the Boston & Maine, has resigned to become manager of the locomotive department of the Ingersoll-Rand Company, New York, which has been organized to handle the oil electric locomotive. W. L. Garrison has been appointed assistant manager of the same department.

The Celotex Company, of Chicago, has closed a contract with the American Refrigerator Transit Company for the insulation of nearly 2,000 refrigerator cars with Celotex. It will require 3,500,000 ft. of Celotex to fill the order. Celotex is an artificial lumber product made from cane fibre and is lighter than ordinary insulating material.

Fred A. Meckert, formerly general manager of the Fort Pitt Spring & Manufacturing Co., and since last April president of the Mitchell Spring & Manufacturing Co., Johnstown, Pa., resigned on August 1, on account of ill health and is now in San Francisco, Cal. Mr. Meckert on his recovery expects to re-enter the same line of business.

F. E. Mills, general credit manager of the Wayne Tank & Pump Company, with headquarters at Ft. Wayne, Ind., has been appointed assistant treasurer, with the same headquarters. C. L. McDavitt, former European financial manager, with headquarters at Paris, France, has been appointed office manager, with headquarters at Ft. Wayne, Ind.

The Buffalo, N. Y., office of the Cutler-Hammer Mfg. Co., in the Ellicott Square building, which was formerly a part of the eastern district, has been made a part of the central district, of which A. G. Pierce is general district manager, with headquarters at Pittsburgh. The central district includes the territories covered by the Buffalo, Pittsburgh, Cleveland and Cincinnati offices. B. A. Hansen is manager of the Buffalo office.

H. M. Richards has been appointed district manager of the American Rolling Mill Company, Middletown, Ohio, in charge of its Cleveland district office at 1408 B. F. Keith building. For a number of years Mr. Richards was located at the home offices, and in recent years, at the Pittsburgh district office. J. T. Hagan, of Cleveland, is associated with Mr. Richards in his new work.

The Gibb Instrument Company, Bay City, Mich., has appointed F. J. DeLima as agent for the sale of its line of electric welding and electric heating machines in the Dominion of Canada. Mr. DeLima's headquarters are in the Keefer building, Montreal. D. A. Clements has been appointed representative of the Gibb Instrument Company in Missouri and southern Illinois, with headquarters at 4167 Washington avenue, St. Louis, Mo.

T. H. King, for the past twelve years sales manager of the Landis Tool Company, has resigned to become treasurer and general manager of the Wayne Tool Manufacturing Company, Waynesboro, Pa. Mr. King, who received his early training in tool manufacturing in the employ of the L. S. Starrett Company, Athol, Mass., and was later employed by the B. F. Sturtevant Company, Boston, Mass., had been actively connected with the Landis Tool Company for the past eighteen years.

Edmund F. Boyle, Pacific coast representative of a number of railway supply companies, with office in San Francisco, Cal., died on July 14, in Los Angeles, Cal. Mr. Boyle went to San Francisco about four years ago as the representative of the following concerns in the Pacific coast territory: Ashton Valve Company; Pilot Packing Company; Locomotive Firebox Company; Nathan Manufacturing Company; Premier Staybolt Company; Grip Nut Company; Magnus Company, Inc.; Heywood-Wakefield Company; Bradford Corporation; Union Metal Railway Equipment Company; Standard Railway Equipment Company; Cincinnati Rivet Cutting Gun Company and the Oxweld Service Company. Mr. Boyle was born on January 5, 1875, and entered the service of the Chicago & North Western in 1889 as water boy and was subsequently in the service of the bridge and building department of that road until 1890. In 1891 he entered the service of the Chicago, St. Paul, Minneapolis, & Omaha and shortly thereafter became a fireman. He then served as engine dispatcher and in 1895 was promoted to engineman. In 1899 he entered the service of the Galveston, Harrisburg & San Antonio in the same capacity and was appointed assistant superintendent in 1913. He was appointed general road foreman in 1914 and entered the service of the Southern Pacific as an engineman shortly thereafter, from which position he resigned in 1920 to enter the railway supply field.

E. F. Boyle

Harold B. Jones, president of the Mid-West Forging Company, with headquarters at Chicago, and a former vice-president of the Inland Steel Company, died on July 18, following a four-day illness of pneumonia. He was in the employ of the Inland Steel Company for 15 years and during the latter two years of his connection with this company he supervised the operation of the company's plant at Chicago Heights. He resigned from the Inland Steel Company in 1923, to become president of the Mid-West Forging Company.

The Victor Tool Company, Waynesboro, Pa., manufacturers of collapsible taps, automatic die heads, floating toolholders, and nut facing machines, has been merged with the Landis Machine Company, Waynesboro, Pa. In the future all correspondence applying to Victor products should be addressed to the Landis Machine Company, Victor plant, Waynesboro. The trade name "Victor" will continue to be applied to the tools formerly made by the Victor Tool Company, and there will be no change in the selling arrangements of these products. This merger permits the Landis

Machine Company to handle both internal and external threading requirements.

Fred P. Pfahler, district master mechanic of the Baltimore & Ohio, with headquarters at Pittsburgh, Pa., has resigned to become associated with the professional staff of the Roberts-Pettijohn-Wood Corporation, engineers and accountants, Chicago. He will devote his entire time to professional work in connection with the introduction of modern methods and improved practices in railway shop management and operation, and as a consultant in railway mechanical engineering work. Mr. Pfahler has spent more than 30 years in railway mechanical engineering work, principally in the employ of the Wheeling & Lake Erie and the Baltimore & Ohio. For four years he was with the Interstate Commerce Commission's Locomotive Inspection Bureau as an inspector. During the period of federal control he served as chief mechanical engineer and as a member of the Committee on Standards of the Central Organization of the United States Railroad Administration. At the conclusion of federal control he returned to the Baltimore & Ohio as district master mechanic.

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has made a number of changes in its sales organization, dividing the company's products into two general classes, engineering and merchandising. T. D. Montgomery, formerly manager of the eastern district, with headquarters at New York, has been appointed assistant sales manager in charge of engineering sales. He is now located at the main office in Milwaukee. A. H. Fleet, formerly manager of the specialty department at Milwaukee, now has charge of the sale of all merchandising products of the company. C. W. Yerger, formerly manager of the Boston office, is now manager of the eastern district, assuming the former duties of Mr. Montgomery. J. M. Fernald succeeds Mr. Yerger as manager of the Boston office. A Milwaukee branch sales office has been opened in charge of J. U. Heuser, formerly of the Chicago office of the company. This Milwaukee branch office is part of the district including Detroit, St. Louis and Chicago, the latter being the main office, of which H. L. Dawson is manager.

The acquisition of additional plants by the Link Belt Company, Chicago, and the extension of its lines and business during the past five years have necessitated changes in the organization. The chairman of the board was made the chief executive officer of the company and an executive committee of four was created to act in an advisory capacity to the officers. Charles Piez, president, was elected chairman of the board and chairman of the executive committee. Alfred Kaufmann, second vice-president, was elected president and will have the general direction and supervision of operations and sales. Staunton B. Peck, retains the position of senior vice-president and directs and supervises operation and sales of the eastern district. A. C. Johnston, formerly in charge of the operations and sales of the Chicago and western district, has been promoted to second-vice-president in charge of operations and sales in the western district. Humphrey J. Kiely, who has had charge of the company's foreign business, as well as the domestic business centering in the New York district, has been elected third vice-president and continues in charge of exports and sales in the New York district. Mr. Kaufmann has been with the Link Belt Company for 24 years beginning in the engineering department and moving successively to the construction department, the general office as assistant to the president, the managership of the Philadelphia plant and to the position of vice-president in charge of the company's Indianapolis operations. For the present, Mr. Kaufmann's headquarters will be at Indianapolis, Ind.

National Railway Appliances Association to Have More Space

The National Railway Appliances Association has arranged with the Coliseum Company, Chicago, for additional space 105 ft. by 172 ft. in area immediately north of the present building for its exhibit next March. The Coliseum Company will build a new structure on this property with spacious doorways connecting with the main exhibit hall, which will add approximately 18,000 sq. ft. of floor space for exhibition purposes. This space will tend to relieve much of the congestion which has prevailed in recent years and will enable the association to more nearly meet all of the demands for space. Floor plans and other information pertaining to the exhibit are being mailed to exhibiting members of the association, and space will be assigned at a meeting of the board of directors in November.

TRADE PUBLICATIONS

Heaters.—A four-page, illustrated bulletin, descriptive of the Breezo-Fin unit heater, has been issued by the Buffalo Forge Company, Buffalo, N. Y.

Chain Hoist.—An improved electric chain hoist, Model No. 20, is described in an eight-page, illustrated folder recently issued by the Yale & Towne Manufacturing Company, Stamford, Conn.

Industrial Gases.—A booklet describing Sunray acetylene and giving a number of rules to be observed in the use of compressed acetylene, has been issued by the International Oxygen Company, Newark, N. J.

Security Latch.—This latch designed to prevent grate shaker bars from working loose while being used, is described in a four-page bulletin recently issued by the United States Metallic Packing Company, Philadelphia, Pa.

Electric Tools.—Portable electric drills and reamers, grinding and buffing machines, etc., are described and illustrated in a 48-page booklet, Catalogue No. 32, being issued by the Hisey-Wolf Machine Company, Cincinnati, Ohio.

Speed and Feed Tests.—The records of the tests made on Cleforge high-speed drills at the American Railway Association convention at Atlantic City in June, are being issued in booklet form by the Cleveland Twist Drill Company, Cleveland, Ohio.

Tapping Devices and Appliances.—Jarvis high-speed tapping devices, tapping machines, quick change chucks and collets, and self-opening stud setters are illustrated and described in a 32-page catalogue recently issued by the Geometric Tool Company, New Haven, Conn.

Safety Appliances.—A few important court decisions relative to United States Safety Appliances are described in Bulletin No. 2 recently issued by the Allegheney Steel Company, Brackenridge, Pa. The ASCO self-fitting torsion spring A. R. A. journal box lid and its application are also described.

Locomotive Superheaters.—The origin, development and results of the Elesco locomotive superheater is the subject of a 24-page illustrated booklet just issued by the Superheater Company, New York. A brief historical sketch of the Superheater Company is given, also a brief outline of the introduction of the Schmidt superheater in this country.

Storage Tanks.—The Conveyors Corporation of America, Chicago, has published a new booklet describing the American cast iron storage tank, which is a sectional tank for the storage of dry, loose, bulky material, such as ashes, coal, sand, gravel, etc. The booklet is illustrated with diagrams and half-tones of tanks in use, and contains a table of weights, measures and capacities.

Reference Book.—The second edition of a 64-page, illustrated reference book of vertical turret lathe practice in railroad shops has been issued by the Bullard Machine Tool Company, Bridgeport, Conn. Installations from various shops throughout the United States are shown and, in most cases, diagrams indicate the tool equipment and operation layout. Specifications for the 24-in. and 36-in. turret lathes, the 44-in. Maxi mill and the Bullard driving box borer and facer are also given.

Automatic Control of Combustion.—Catalogue No. 99, which is made up of two bulletins treating of the automatic control of combustion and systems for the automatic control of combustion respectively, has been issued by the Carrick Engineering Company, Chicago. The former bulletin contains a complete discussion of automatic control methods and systems and brings out the limitations of the various systems and why they fail. The conditions to be met in co-ordinating supply of steam with the demand are analyzed and interesting charts of steam pressures are given, the fallacy of close steam regulation is exploded, and a graphic record of damper positions shows the comparative permanence of automatic control. Complete specifications, together with diagrams and a list of equipment required for thirty-three distinct methods of automatically controlling boiler room equipment, are given in the latter bulletin.

PERSONAL MENTION

Car Department

E. Posson, engineer of car construction of the Atchison, Topeka & Santa Fe, with headquarters at Chicago, has retired. Mr. Posson was born on July 3, 1860, at Port Washington, Wis. From 1875 to 1878 he learned the machinist trade in a commercial shop at Port Washington and from the latter date until 1883 he was a pattern maker for the Milwaukee, Lake Shore & Western, (now a part of the C. & N. W.) at Manitowoc, Wis. From 1883 to 1890 he was chief draftsman and from 1890 to 1892 he was superintendent of the Atlas Iron Works at New Duluth, Minn. On the latter date he entered the employ of the Northern Pacific as chief draftsman in the mechanical department at St. Paul, Minn. In 1903 he entered the employ of the Atchison, Topeka & Santa Fe as engineer of car construction, with headquarters at Topeka, Kans., being transferred to Chicago on July 15, 1904.

E. Posson

Shop and Enginehouse

W. S. Cozad has been appointed shop supervisor of the Packerton, Pa., shops of the Lehigh Valley. Previous to this appointment, Mr. Cozad was engaged in efficiency engineering work on various railroads, including the Chicago, Burlington & Quincy, the Michigan Central and the Norfolk & Western, and served successively as shop specialist and superintendent of apprentices and piecework of the Erie. He then became production manager of the McCord Manufacturing Company, Detroit, Mich. During the war he was engaged in repair work on the German boats and with the Bethlehem Steel Company at Quincy, Mass., building destroyers.

Purchasing and Stores

John Thomson has been appointed chief stores accountant of the Chesapeake & Ohio, with headquarters at Huntington, W. Va.

E. R. Brinton, general storekeeper of the Chesapeake & Ohio at Covington, Ky., has been appointed assistant general storekeeper, with the same headquarters.

J. H. Lauderdale has been appointed general purchasing agent of the International-Great Northern, with headquarters at Houston, Tex., to succeed C. B. Porter, resigned.

J. P. Kavanagh, general storekeeper of the Chesapeake & Ohio, with headquarters at Huntington, W. Va., has had his jurisdiction extended over the entire system.

Elmo Edwards has been appointed purchasing agent and general storekeeper of the Spokane, Portland & Seattle, with headquarters at Portland, Ore., succeeding Paul McKay, who has resigned.

W. L. Monning, assistant to the superintendent of stores of the Chesapeake & Ohio, at Huntington, W. Va., has been appointed assistant to the general storekeeper, with the same headquarters, the position of assistant to the superintendent of stores having been abolished.

A. H. Young, Jr., general storekeeper of the Chesapeake & Ohio at Clifton Forge, Va., has been appointed assistant general storekeeper, with the same headquarters, the positions of general storekeepers of the Western and Eastern general divisions having been abolished.

F. G. Prest, whose retirement as director of purchases of the Northern Pacific, with headquarters at St. Paul, Minn., was reported in the August issue of the *Railway Mechanical Engineer*, was born on January 5, 1854, at Queenston, Ont. He entered railway service in 1880 as a clerk in the purchasing department of the Northern Pacific at St. Paul, and held that position until 1882 when he was promoted to chief clerk in the same department. Mr. Prest was promoted to assistant purchasing agent, with headquarters at St. Paul, in 1891 and in 1896, was promoted to purchasing agent. He was promoted to director of purchases, with the same headquarters, in November, 1921, and continued in that capacity until his recent retirement. Mr. Prest's entire railway service of 44 years was with the Northern Pacific.

F. G. Prest

Obituary

Edmund T. Burnett, who retired as general purchasing agent of the Norfolk & Western on December 31, 1920, at Roanoke, Va., died at a hotel in New York on July 14 following a short illness. Mr. Burnett was born at Philadelphia, Pa., on December 10, 1843, and entered the service of the Norfolk & Western on April 10, 1882, as chief clerk to the purchasing agent, with headquarters at Philadelphia. He was appointed assistant to the purchasing agent on January 1, 1891, with headquarters at Roanoke and in May, 1893, he was appointed purchasing agent, with headquarters at Philadelphia. In 1896 he was transferred back to Roanoke. At the beginning of the period of federal control Mr. Burnett was appointed regional purchasing agent of the Pocahontas region, with headquarters at Roanoke, and at the termination of federal control he was appointed general purchasing agent of the Norfolk & Western, in which capacity he served up to the time of his retirement in 1920.

Aluminum Cars and Locomotives Suggested by Gen. Atterbury.—The possibility of the development of an aluminum alloy at a cost that would enable its use in locomotive and car construction, with a large reduction in weight and consequent decrease in the cost of transporting freight, was suggested by Gen. W. W. Atterbury, vice-president of the Pennsylvania Railroad, in testifying before the Senate committee on agriculture on April 19 in connection with the bid made to the government by himself, J. G. White and Elon M. Hooker for the Muscle Shoals property, which Henry Ford is also seeking. The cheap electric power available at Muscle Shoals, Mr. Atterbury said, would give an opportunity for experimentation to reduce the cost of the metal to a practicable figure.

Referring to the fact that during the war German Zeppelins were made from an alloy of aluminum and magnesium, Mr. Atterbury said that if the bid is accepted he plans to devote considerable time to research work in an effort to manufacture railroad cars out of this aluminum composition. The metal would not have the strength of high carbon steels, but it could be used as a substitute for steel in a large part of either car or locomotive construction. He said it might be possible to cut down the weight by 50 per cent; and although the question whether it is possible to produce the aluminum composition at a cost which would make its use for cars feasible would have to be demonstrated, the efficient production of aluminum at low cost is directly dependent upon cheap electricity. General Atterbury said that the metal he has in mind would have approximately 25 to 35 per cent of the weight of steel.